

**Charles University in Prague**

Faculty of Social Sciences

Institute of Economic Studies



**MASTER THESIS**

**The Impact of Electoral Cycles on Monetary  
Policies in Advanced and Developing  
Economies**

Author: Adrian Lupusor

Supervisor: Roman Horvath Ph.D.

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# Master Thesis Proposal

Institute of Economic Studies  
Faculty of Social Sciences  
Charles University in Prague



<b>Author:</b>	<b>Bc. Adrian Lupusor</b>	<b>Supervisor:</b>	<b>Prof. Roman Horvath, Ph.D.</b>
E-mail:	adrian.lupusor@gmail.com	E-mail:	roman.horvath@gmail.com
Phone:	77 6874596	Phone:	222 112 317
Specialization:	Economics & Finance	Defense:	June 2012
		Planned:	

*Notes: The proposal should be 2-3 pages long. Save it as "yoursurname\_proposal.doc" and send it to [mejstrik@fsv.cuni.cz](mailto:mejstrik@fsv.cuni.cz), [tomas.havranek@ies-prague.org](mailto:tomas.havranek@ies-prague.org), and [zuzana.irsova@ies-prague.org](mailto:zuzana.irsova@ies-prague.org). Subject of the e-mail must be: "JEM124: Thesis Proposal Yoursurname".*

## Proposed Topic:

The Impact of Political Cycles on Monetary Policies in CEE and OECD and its Effects on Monetary Policy Transmission. A Comparative Analysis

## Topic Characteristics:

According to the political business cycle theory, the political incumbents wishing to be reelected for the next term, exercise significant pressures on the monetary authorities in order to decrease as much as possible the unemployment and to foster the output growth before elections. This is done by engineering some inflation, which spurs the nominal incomes of the voters. If this is the case, the assumption of central bank independence employed in most of monetary policy analysis is irrelevant. Therefore, in this master thesis I will test for significance the impact of electoral cycles on the monetary policy among several CEE and OECD countries. In this way, I will perform a comparative analysis between two groups of developed and developing countries, with different institutional experience and overall economic development. The implication of such kind of comparative analysis is quite important for public policies, because it reveals the institutional deficiencies linked with the central banks' independence. Respectively, it can explain to a certain extent the reasons why the transmission of monetary policy is slower in countries where the monetary authorities are most vulnerable to political pressures. The main data sources will be OECD statistical database, websites of analyzed central banks, national bureaus of statistics of analyzed countries and several portals gathering data about elections: [electionresources.org](http://electionresources.org), [electionguide.org](http://electionguide.org), [alegeri.md](http://alegeri.md).

## Hypotheses:

1. The central banks are pressed by politicians to promote a looser monetary policy before elections, in order to ensure, on the short-run, a more dynamic output growth.
2. The influence of electoral cycles on the monetary policy is less observed in OECD than in CEE countries, due to a higher degree of independence enjoyed by the first ones.
3. In countries where the election induced monetary policy is statistically significant, the monetary policy transmission is slower.

**Methodology:**

In order to estimate the impact of electoral cycles of monetary policies I will use 2 econometric approaches for double checking. The first one is the threshold non-linear OLS model which allows for controlling the asymmetric behavior of the central bank in response to inflationary under- and overshooting (Taylor and Davradakis, 2006). Thus, I will estimate a non-linear Taylor rule with an incorporated electoral variable, while the central bank is supposed to run 2 regimes: 1. Inflationary overshooting regime - it is expected to tackle the inflationary pressures more aggressively, particularly by increasing its policy rate; 2. Inflationary undershooting regime - it is expected to promote a more accommodative monetary policy. Correspondingly, if the electoral variable proves statistically significant, we can conclude about electorally induced monetary policy. The second econometric approach is state space modeling which will be used in order to measure the time-varying responses of the central bank to inflation and for graphical illustration of electoral shocks on monetary policy stance (Baxa, Horvath and Vasicek, 2010; Harvey, 1989; Hamilton, 1994). Finally, the

**Outline:**

1. Estimating The Impact of Electoral Cycles on Monetary Policies?
  - a. Theories Behind Election Induced Monetary Policies
  - b. The Data Description
  - c. The Models Description
2. Do the Central Banks in Developed Countries Enjoy More Political Independence then in Developing Ones?
  - a. Empirical Results Interpretation
  - b. Decifering the differences between OECD and CEE countries
  - c. Discussion about the Main Determinants of Political Independence of Central Banks
3. The Importance of Central Banks' independence for Monetary Policy Transmission
  - a. Theories Behind Monetary Policy Transmission
  - b. Descriprion of the data
  - c. VAR Model Description
  - d. Discussion of the Results

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## **Declaration**

The author hereby declares that he compiled this thesis independently,  
using only the listed resources and literature

Prague, April 16, 2012

Adrian Lupusor

# Abstract

The thesis provides a comparative estimation of the electoral cycles' influence on the monetary policies among a group of developed and developing countries. We use a non-linear central bank's reaction function which captures the regime switching behavior of the monetary authority depending on the proximity of elections. Moreover, we compare the reaction function with partial adjustment, which controls for policy inertia, with a non-inertial policy rule with serially correlated errors which takes into account other shocks determining the central bank to deviate from its policy rule. The estimation was performed via OLS, 2SLS and 3SLS, the preference being given to the last one due to correction of endogeneity problem and efficiency gains. Robust evidence about election induced monetary policies was found in 2 out of 10 developed economies and 4 out of 10 developing economies. In these countries, the central banks tend to be less inflation averse and/or less counter-cyclical (or even pro-cyclical) during electoral periods in comparison with normal times. Additionally, we find that the legislative framework, in these countries, incorporates significant deviations from the best practices of central bank independence. Finally, following the dynamic inconsistency problem, we document a strong inflationary bias in the economies with politically sensitive monetary policies. It confirms the imperative importance of central bank's reputation, insulation of monetary policy from the fiscal one and the necessity of an adequate legislative design to ensure the full independence of the monetary authority.

## Keywords

Monetary Policy, Central Bank Reaction Function, Political Monetary Cycles, Dynamic Inconsistency Problem, Inflation Bias, OLS, 2SLS, 3SLS.

**Author's email:** [adrian.lupusor@gmail.com](mailto:adrian.lupusor@gmail.com)

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***"As goes politics, so goes economic policy and performance. This is the case because, as goes economic performance, so goes election"***

Tufte E.R., 1978

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## List of Abbreviations

2SLS	Two-Stage Least Squares
3SLS	Three-Stage Least Squares
CPI	Consumer Price Index
GLS	Generalized Least Squares
GDP	Gross Domestic Product
HP	Hodrick-Prescott
IMF	International Monetary Fund
IPI	Industrial Price Index
OECD	Organization of Economic Co-operation and Development
OLS	Ordinary Least Squares
PMC	Political Monetary Cycles
RHS	Right Hand Side
STI	Short-Term Interest Rate

# Introduction

The year 1989 marked a turning point for a new era in central banking: the Reserve Bank of New Zealand adopted a new Act which made this country the first to embark upon inflation targeting. Respectively, it was accompanied with ensuring a better insulation of the monetary policy from the fiscal one. Soon, it was followed by other countries all over the world which started in depth reforms aimed at increasing the operational and political independence of the central banks (Cukierman, 1992). What was the main driving force which shifted the mainstream among researcher and policy circles? The catapulting inflation of '70 and '80 and the failure of central banks to keep the prices stable uncovered the problem of time inconsistency and optimal commitment policies (Kydland and Prescott, 1977). The main explanation lied in the perverse incentives of incumbent politicians who had enough tools to exercise pressures on the monetary authorities in order to boost on the short-run the economy above its potential level, in order to create more jobs and buy more votes before elections. Under such political constraints, the central banks proved to be unable to keep prices low and stable.

Despite the broad consensus on the importance of clear separation of the monetary policy from fiscal one and its insulation from electoral cycles and political manipulations, the recent sovereign debt crisis posed new challenges to the central banks' independence. Particularly, it owes to unconventional monetary policies implemented in many countries, through which the central banks all over the world, including FED and ECB, resorted to money creation by purchasing large amounts of sovereign debt. In this way, the separation of monetary policy from the fiscal one was blurred, while the inflationary risks significantly increased. In light of these new trends, the issue of central banks' independence became again a heated topic of discussion among researchers, policy makers and media.

How and why the politicians are motivated to tilt the monetary policy into their interest? According to the political business cycle theory (Nordhaus, 1975), the political incumbents wishing to be reelected for the next term, exercise significant pressures on the monetary authorities in order to decrease as much as possible the unemployment and foster the output growth before elections. Therefore, the central banks are persuaded to implement a monetary expansion in the electoral periods in order to boost the aggregate

demand. In this way the opportunistic politicians use the monetary policy as a tool to exploit the Phillips curve (short-run trade between inflation and unemployment) to buy votes from the myopic electorate who heavily discount the future.

Most of the central banks around the world are - or at least – *pretend* – to be politically and financially independent institutions. This is stipulated either in a normative law or the Constitution, which act in accordance with an *ex ante* set objective(s). Therefore, the central bank independence is a commonly used assumption employed in the quantitative and qualitative analysis related to monetary policy. According to it, the central bank follows firmly its social loss minimization function by steering the price level and inflationary expectations and promoting a counter-cyclical policy with respect to output level.

Nevertheless, we have to keep in mind that the monetary authorities in most countries are *public* institutions, the Governors are usually appointed by the legislative power, in some cases the central bank's objective is defined by the Government and, especially in developing countries, the board members have close ties with the incumbent political party or coalition. Given the desire of the ruling party to get reelected for the next term, we can suspect a politically induced monetary policy influenced by electoral cycles, which is an important topic for empirical research.

In this paper we test for significance of the impact of electoral cycles on the monetary policies. Particularly, we perform a comparative analysis between two groups of developed and developing countries, with different institutional experience and economic development. The implication of such kind of comparative analysis is quite important for public policies, because it reveals the institutional deficiencies linked with the central banks' independence. Respectively, it can explain to a certain extend the reasons why the transmission of monetary policy is slower in countries where the monetary authorities are most vulnerable to political pressures. Thus, based on the results from our estimation of electoral induced monetary policies, we analyze the main explanatory factors which make the central banks vulnerable to political pressures, as well as the outcomes of these Political Monetary Cycles (PMC).

Unlike most of the papers which assume a linear and static central bank reaction function, the analysis is performed using a regime switching non-linear estimation of the monetary policy Taylor rule. It allows for comparing the estimated coefficients in

two regimes: (i) the electoral one (4 quarters before the election's day) and (ii) the non-electoral one (the rest of the period). Therefore, the evidence of electoral influence on monetary policy will be confirmed in cases where the coefficients standing for inflationary pressures and those for output gap will be lower during electoral periods in comparison with the normal times.

The thesis is structured as follows. The Chapter 1 provides a comprehensive literature review on the research conducted so far in this area, mentioning the main channels of political influence on the monetary policies, the most often methodology employed, as well as the main unexplored research fields. Chapter 2 discusses the theoretical methodological framework which will be used in this thesis. It provides a description of the econometric models employed for testing the PMC hypothesis, as well as the non-linear specification of the central banks' reaction function. Chapter 3 outlines the hypotheses which are tested using the methodology described in the chapter 2 and provides a discussion about the empirical results. The main explanatory factors making some central banks vulnerable to political manipulations are discussed in chapter 4. The chapter 5 introduces the dynamic inconsistency problem and analyzes the outcomes of politically sensitive central banks. The final concluding remarks are outlined in the chapter 6. The reference list and annexes including the regression results and Gretl script can be found at the end of the document.

# **Chapter 1: How Monetary Policy can switch to Monetary Politics?**

## **1.1 Introductory Remarks**

This chapter presents a comprehensive review of research conducted so far on the issues related to political constraints imposed on the monetary policy, mainly through the theory of Political Business Cycles or Political Monetary Cycles developed in '70. First of all, I will present the main models which describe the central banks' behavior under political pressures and how they may change their reaction functions to inflation and unemployment. This theoretical insight about election induced monetary policies will be followed by an illustration of the empirical evidence about the persistence of political pressures on the central banks from many countries all over the world. Since it is directly related to the way how politicians and electorate perceive the inflation and unemployment – the main determinants of central bank's reaction functions – we will provide some research background on political inferences of these crucial macroeconomic indicators. The final part of this chapter comprises a review of the main methodological tools used for estimating the degree of political influence on the monetary authorities.

The democratic systems create 2 main types of incentives for incumbent politicians to exercise pressures on the monetary authorities: (i) electoral and (ii) partisan ones. As a result, the research on political constraints on central banks can be divided into 2 main directions: (i) electoral-motivated and (ii) partisan-motivated monetary policies. The first one is related to the so-called Political Business Cycles theory, according to which the incumbent politicians influence the central bank reaction function before elections in order to spur output growth and decrease unemployment. The second theory states that the monetary policy is influenced by the party ideology, such that right-wing parties, which are represented mainly by owners of capital, force the central banks to implement more aggressive monetary policies with respect to inflation; while the left-wing parties, which are represented by owners of human capital, try to tilt the monetary policies in order to stimulate employment.

## 1.2 Channels of Influence

Before going into details about each of these models of political influence of the central banks, it is worth mentioning the most seminal research papers aimed at underlying the main channels of influence. Havrilesky (1995) provides an interesting discussion about the reason of political influence on FED, which accommodates the presidential wishes before election in exchange for political protection against legislative initiatives which could threaten its independence in the period after elections. In this way, the central bank gives up its independence in the short run, in order to gain more independence in the long run.

A crucial channel of political influence, widely discussed by researchers, is the power of appointment. Thus, Havrilesky and Gildea (1992) argue that presidents usually chose economists which have similar views and ideologies. Additionally, Waller (1989) and Keech and Moris (1997) found that due to the influence through the power of appointment the political regime changes cause sluggish policy shifts in the central bank as the president spend some time for “packing the Board” with loyal supporters. Thus, we can notice that this channel of influence causes more often partisan motivated monetary policy, which has been revealed by Chappell, Havrilesky and McGregor (1993).

Since in most central bank the monetary policy stance is decided at the periodic meetings of committee members, the persistence of the power of appointment channel can be depicted by the analysis of committee decisions based on the voting of each committee member. For example, Chappell, Havrilesky and McGregor (1993) argue that the Fed Chairman has disproportionate weights in committee decisions which undermine the simple median voter hypothesis. Additionally, McGregor (1996) found how committee decisions were influenced by the electoral cycles. Thus, he empirically estimated that before elections the members appointed by the party of the incumbent president were voting for easier policy stance, while the members of opposition favored more tightness.

### *Electoral-Motivated Monetary Policies*

The first most seminal and well-known paper which introduced the notion of Political Business Cycles was that of Nordhaus (1975) who defined a micro- and macroeconomic



framework according to which the economics and politics are closely interrelated. The main assumptions employed by the author where:

- a) The economy can be described by an “expectations augmented” Philips curve;
- b) Expectations are adaptive;
- c) Politicians have control over the aggregate demand through a set of instruments (e.g. monetary or fiscal policy)
- d) The primary aim of politicians is to get elected and/or reelected (“opportunistic behavior”)
- e) Voters value high output, low unemployment and inflation. They are retrospective and make their electoral decisions based on the past performance of politicians. Additionally, they heavily discount the future (“myopic voters”).

Thus, he argued that incumbent politicians wishing to be reelected seek for votes’ maximization by influencing the myopic electorate whose preference function is driven mainly by inflation and unemployment and who have adaptive expectations (the expectations of current policy are based on past policy). As these variables are the main factors which guide the monetary policy decisions, the incumbent party may exercise some political pressures in order to shape the central bank’s behavior. As a result, during electoral periods the monetary policy may be pro-cyclical and not counter-cyclical as the theory suggests. Additionally, before elections incumbent politicians, by use of easy monetary policy, engineer economic booms, which are followed by an economic contraction in the post-election period. Hence, the inflation is higher in the proximity of elections due to pre-electoral expansionary monetary policy and gets lower after some periods after elections as a result of monetary contraction. In any case, the economy which is subject to Political Business Cycles is characterized by stronger “inflation bias”, where the level of inflation is higher than the “social optimum”.

It is worth mentioning that the assumption that the voters prefer incumbents who achieved better macroeconomic results is supported by most office-seeking models. Thus, Kramer (1971), Stigler (1973), Tufte (1978), Arcelus and Mertzner (1975), Fair (1978 and 1988) and Hibbs (1987) provide robust evidence that higher economic growth, lower unemployment and inflation explain the incumbent parties’ success in US presidential elections. These findings are supported by more evidence from Germany,

France, Italy, UK and Spain by Beck (1988), and from Denmark, Norway and Sweden by Madsen (1980).

The research in this area is enriched by the influential Gordon's model (1975), where the main aim of the incumbent politicians is to get reelected, while their popularity ratings directly depend on economic conditions. As voters usually seek lower taxes, higher wages, lower unemployment and higher output, the politicians exercise pressures on the central banks' in order to support these policies before elections. Correspondingly, it turns into an easier monetary policy before elections and tighter one after elections in order to overcome the engineered inflation. This issue was comprehensively analyzed by Wright (1974), Tufte (1978), Frey and Schneider (1978), Golden and Poterba (1980), Schultz (1995) and Price (1998) who found that incumbents' incentives to electioneer are rising with expected proximity of elections. Moreover, according to Alt (1985) these incentives are lower the bigger is the number of elected policy makers sharing the power.

In early '90s emerged a new wave of models based on rational expectations theory which reformulated the initial Nordhaus conception of "political business cycles". The most important assumption employed by these models is related to the utility function of governments, which is similar to that of private agents, except their "opportunistic behavior". Thus, governments tend to use all the available instruments in order to maximize their utility function from winning the elections and getting more power. The most prominent exponents of this upgraded view on the political business cycles theory are Rogoff and Sibert (1988), Rogoff (1990) and Persson and Tabellini (1991).

Alesina, Cohen and Roubini (1991) wrote a seminal paper for a panel of 18 OECD countries in which they found that the monetary policy is usually easier before elections while the inflation is higher after elections. This may be the cause of the pre-electoral monetary expansion as a result of the political pressures on the central banks from the incumbent parties. At the same time, the paper did not validate the Nordhaus theory of Political Business Cycles, as they found no evidence that the economic growth and employment are higher before elections. Additionally, the estimates of election induced monetary policy wasn't stable, being interpreted by the authors that there are some electoral cycles in monetary policy stance, but these cycles do not occur always and in each country of the analyzed panel.

Nowadays, there is still no consensus among academic circles on the evidence of political business cycles theory as it wasn't validated by some empirical studies. For example, Alesina (1997) finds little signs of pre-electoral effect on monetary policy in USA. However, in most cases, the researchers rejected the evidence of policy outcomes (e.g. increasing output and decreasing unemployment before elections), while the evidence of electoral manipulations with policy instruments (e.g. monetary and fiscal policy) is mixed. For example, McCallum (1978), Paldam (1979), Golden and Poterna (1980), Hibbs (1987) and Alesina and Roubini (1990) rejected the Nordhaus theory.

### *Partisan-Motivated Monetary Policies*

Whereas, according to the election-motivated monetary policies the policy makers are perceived as office-seekers, the partisan approach treats them rather as policy seekers. The reason is behind the different motives of monetary policy manipulation: in the first case the incumbent party is described by a purely opportunistic behavior, wishing to be reelected and caring little about policies and outcomes per se; and, in the second case, political parties do care about policies and, therefore, are trying to persistently influence the central bank's behavior according to their ideology.

Nordhaus (1975) mentions another channel of influence by politicians on the monetary policy stance – “parties’ ideology”. Thus, the trade-off between inflation and unemployment, also known as the “Phillips Curve”, is differently perceived by parties’ principles: some of them (e.g. Republicans) might put more emphasis on keeping inflation as low as possible, while others (e.g. Democrats) – on minimizing unemployment, even with a cost of inflation. These findings were confirmed by Hibbs (1977), who observed that the unemployment rates were lower under left-wing than under right-wing political regimes. A similar evidence has been provided by Cowart (1978) for governments from Europe.

There is mammoth additional research evidence about the persistence of partisan induced monetary policies, especially for USA. Thus, a significant added-value was brought by Hibbs (1987), who estimated that Democrat supporters penalize incumbents 1.1 times as much for unemployment as for inflation, whereas Republican supporters and Independents supporters punish them only 0.65 and 0.49 times as much for unemployment as for inflation. Additionally, Beck (1982) and Chappell (1993) found partisan monetary effects via federal appointments. Johnson (1995), Simmons (1996),

Oatley (1999), Franzese (1999, 2002) got similar findings with larger samples, controlling the domestic and international institutional and structural context. Additionally, Alesina, Roubini and Cohen (1997) provided robust empirical evidence supporting the rational partisan cycles across a panel of 18 OECD countries.

However, as in the case of electoral-motivated monetary policies, there is no consensus on the persistence of partisan induced cycles. Hence, some researchers are quite skeptic about the impact of incumbent party ideology on the monetary policy. For example, Sieg (1997), Vaubel (1997) and, especially, Cusack (2000), finds evidence about partisan monetary policy only under right-wing governments, while in the case of left-wing governments the results are not statistically significant. Moreover, Clark (1998) using several combinations of central bank autonomy, exchange-rate regimes and capital mobility, argues that there is no evidence about partisan monetary policies. Alesina (1997), also, did not find strong partisan differences in money growth for USA. Similar skepticism is shared by Alesina and Perotti (1995), Hahm (1996), Ross (1997) and Boix (2000). Such divergences between researchers' findings are explained by Schmidt (1987) who suggests that the evidence about partisan monetary policies depends heavily on the international and domestic political-economic institutional, structural and strategic context.

### **1.3 Evidence about Election Induced Monetary Policy**

Nordhaus (1975), who pioneered the research on electoral induced monetary policy, presented, also, some empirical evidence in this area. Thus, in the period 1947-1972 he finds that the political business cycles were observed in Germany, New Zealand and United States and, to a lower extend, in United Kingdom, Australia, Canada and Japan. In these countries, the polities tend to be expansionary before elections, as the unemployment rate has been decreasing while inflation – increasing, while after election – vice-versa. Tufte (1976) supported this evidence, mainly for USA, proving that some presidents provoked election-year economic booms to ensure their reelection. The research was continued by Weintraub (1978) and Pierce (1978 and 1979), who, also, found a politically induced monetary policy, based on monetary growth acceleration prior elections and its deceleration after elections for USA; and by Duesenberry (1983) who also argued that FED was indeed influenced by political considerations.

The '80s are marked by a new wave of research of political influence on monetary policies, which was, also, extended from USA to the old continent. Thus, Aftalion (1983) found some empirical evidence for France according to which the changes of Government shaped the central bank's reaction function. Additionally, Willms (1983) found that in situations of conflict between the Government's output growth objective and the Bundesbank's price stability objective, the central bank could not resist the political pressures and had to follow the Government policy.

These findings were confirmed by the research conducted over the last 2 decades. Hence, Alesina (1992 and 1993), provided robust empirical evidence about monetary expansion prior elections in a dataset for OECD countries. Franzese (1999, 2002), also, finds some post-electoral inflation surges for OECD countries which constitute a lagged effect of monetary expansion before elections. This evidence is confirmed by Clark and Hallerberg (2000) and Hallerberg (2001 and 2002). The electoral induced monetary policy is, also, found in most of studies on developing democracies: Ames (1987), Krueger and Turan (1993) and Remmer (1993).

Still the most comprehensive research on political monetary cycles has been conducted for the USA. Thus, Kane (1980 and 1982) argued that FED faces a lot of political constraints which causes sub-optimal monetary policy. Grier (1987) identified a regular 16 quarters cycle in money growth corresponding with presidential elections in US and after the simulation of a simple macro model a classical political business cycle for inflation and unemployment was obtained. Beck (1987) and Sheffrin (1989) also report about US electoral monetary cycles, as the money growth get higher before elections.

### *Political Economy of Inflation and Unemployment*

The trade-off between inflation and unemployment and, particularly, how it is perceived by parties and voters forms a crucial research area which is directly related to the political influences on the central bank's behavior. Thus, the seminal paper of Nordhaus (1975) argues that the electorate wants both low unemployment and low inflation. However, due to the lagged effect on the price level as a result of a money supply shock the politicians prefer to use the monetary policy for stimulating the output and combating the unemployment before elections and manage the inflationary pressures after. Therefore, since both politicians and voters in a democratic system are considered to be myopic by nature, their short-term preferences are biased in favor of lower

unemployment and higher inflation than the optimum. Respectively, this is the main source of political pressures on central banks, which are forced, before elections, to be less assertive about inflation and promote an easier monetary policy in order to keep the unemployment as low as possible. This assumption is confirmed by Gordon (1976), who had an influential contribution in arguing that a major cause of the supply of inflation is the elections' proximity which makes the myopic incumbent party to force increasing money supply. The reason for this is to satisfy the demand for inflation as a result of the need to increase nominal government expenditures or wages.

These findings of Nordhaus and Gordon are supported by the theory of time inconsistency problem developed by Kydland and Prescott (1977) which explain the political bias towards inflationary policies. Barro and Gordon (1983) applied this theory to monetary policy. Basically it states that, since policymakers value both low inflation and high output, in case of steering inflationary expectations at zero level, policymakers have the incentive to spur output through a money supply shock. However, this doesn't hold due to rational expectations, which make the public to anticipate the future actions of the monetary authority. The final results is that inflation will be always positive in equilibrium, at the level where marginal costs of inflation equal marginal gains in output. Therefore, in order to avoid suboptimal inflationary equilibrium, it is necessary to appoint a conservative policymaker who is less concerned about output than inflation (Rogoff, 1985). Additionally, it is crucial to ensure a full independence of the central bank, as Cukierman (1992) finds a close connection between independence of the monetary authority and low inflation.

Another important source of political demand for inflation is the seigniorage, which can ensure the government with an important source of revenue when the tax institutions are less efficient and political systems are less stable (Cukierman, 1992). Additionally, inflation may be supplied by the central bank itself for revenue purposes. Thus, Toma (1982) argued that the Fed usually deals with bureaucratic incentives for monetary expansion, as it implies trading no-interest bearing cash for interest-bearing bonds which fund its operational budget. Tollison and Shughart (1983) supported this theory by providing empirical evidence that the monetary expansion is associated with increasing employment of Fed.

## 1.4 Methods of Estimation

A common approach in assessing the impact of electoral cycles on the monetary policies is the analysis of central bank's reaction function. Particularly, the research is conducted either by looking at how this reaction function evolves over time (e.g. whether it is subject to some cyclical disturbances associated with the elections periods) or dummy variables for each election year.

Willms (1983) uses an extension of social loss function, incorporating the rate of inflation and unemployment, as well as output growth, which shape the central bank's monetary policy instruments according to the formula:

$$CBM_t = CBM_t^* - \frac{a_1 a_{11}}{b} P_t - \frac{a_2 a_{21}}{b} Y_t - \frac{a_3 a_{31}}{b} U_t + \frac{a_1 a_{11}}{b} P_t^* + \frac{a_2 a_{21}}{b} Y_t^* + \frac{a_3 a_{31}}{b} U_t^*, \text{ where:}$$

$P_t$  and  $P_t^*$  – rate of inflation and desired rate of inflation

$Y_t$  and  $Y_t^*$  – growth rate of real GNP and potential rate of real GNP

$U_t$  and  $U_t^*$  – unemployment rate and neutral unemployment rate

$CBM_t$  and  $CBM_t^*$  – growth rate of Central Bank Money and its neutral growth rate.

Respectively, the author found that in periods when Bundestag's objective was contradicting the Government policy, the reaction function was biased in favor of stimulating the output growth and decreasing the unemployment with some inflationary costs. Thus, higher coefficients for unemployment and inflation revealed the preference of the monetary for these objectives.

Grier (1987) builds a model where the money supply is regressed on its autoregressive components, reflecting some kind of policy inertia, and a set of dummy variables standing for different shapes of electoral monetary policy cycles. Thus, the model tests whether any of these electoral variables Granger-cause money growth:

$$\Delta M_t = \beta_0 + \beta_1 M_{t-k} + \beta_2 EC1 + \beta_3 EC2 + \beta_4 EC3 + \beta_5 EC4 + \beta_6 EC5 + \beta_7 EC6 + e_t, \text{ where}$$

$\Delta M_t$  – change in money supply (M1)

$M_{t-k}$  – autoregressive component of money supply

$EC1 - EC6$  – dummy variables for various shapes of electoral cycles

Allen (1986) extended this model by introducing additional explanatory variable into the equation, such as output gap ( $GAP_t$ ), unemployment ( $U_t$ ), inflationary expectations ( $P_t^e$ ), net federal debt ( $DEBT_t$ ), three-month Treasury Bill rate ( $RS_t$ ), and a dummy variable defining the electoral cycles ( $EV$ ).

$$\Delta M_t = \beta_0 + \sum_{i=1}^5 \beta_i M_{t-i} + \beta_1 GAP_t + \beta_2 U_t + \beta_3 P_t^e + \beta_4 DEBT_t + \beta_5 RS_t + \beta_6 EV$$

Alesina and Roubini (1991) used another straightforward empirical tool in estimating the implications of opportunistic political business cycles theory on the monetary policy. Similar to the model of Grier (1987 and 1989), they used the following equation for the pooled cross-section time-series:

$$m_{it} = \beta_0 + \beta_1 m_{it-1} + \beta_2 m_{it-2} + \dots + \beta_n m_{it-n} + \beta_{n+1} PBCN_{it} + e_t, \text{ where}$$

$m_{it}$  – the rate of money growth (M1) in country  $i$  in time  $t$ .

$PBCN_{it}$  - the electoral dummy which takes on a positive value for the last 3 or five quarters before the election and during the quarter of the election.

Additionally, Alesina and Roubini (1991) use the following model for testing the “partisan/opportunistic” interaction:

$$m_{it} = \gamma_0 + \gamma_1 m_{it-1} + \gamma_2 m_{it-2} + \dots + \gamma_n m_{it-n} + \gamma_{n+1} DUML_{it} + \gamma_{n+2} PBCNL_{it} + \gamma_{n+3} PBCNR_{it} + \varepsilon_t,$$

where:

$DUML_{it}$  - dummy variable standing for the left-wing government in country  $i$  in time  $t$ .

$PBCNL_{it}$  and  $PBCNR_{it}$  are the interactions terms between PBCN (the dummy from the previous equation) and the left and right wing government dummies respectively.

However, this estimation method could hardly be employed nowadays since most of central banks use policy interest rates rather than money supply as main monetary policy instruments. Additionally, money supply may increase prior elections due to higher Government expenditures or parties’ expenditures, as well as higher private credit used to financing of electoral campaigns. As a result, there could be a natural increase in money supply, without any political influence on the central bank’s



behavior. Hence in order to avoid spurious conclusions about political monetary cycles, the money supply variable should be replaced with the central bank's policy rate or short-term interest rates which could better describe the monetary policy stance.

### **1.5 Concluding Remarks: Depicting Main Unexplored Fields**

While the early research was focused mainly on identification of empirical evidence and motivations for electoral induced monetary policies, the last wave of research in this area is related to the linkages between central banks' independence and their vulnerability to political constraints. Thus, Bernhald and Leblang (1999, 2000 and 2002), Franzese (1999 and 2002), Oatley (1999), Boix (2000), Clark and Hallerberg (2000), Clark (2002), argue that incumbents' capacity and effectiveness in manipulating monetary policy depends on central bank's independence.

Respectively, the evidence of electoral monetary policies may be a reliable proxy for measuring the degree of central banks' independence. Assuming that it affects the credibility of the monetary authority and its capacity to steer the inflationary expectations in the economy, a solid body of research may be devoted to assessing the impact of electoral monetary cycles on the efficiency of central bank's policy and its transmission process. Thus, the research should not stop at some pure econometric evidence about the impact of electoral cycles on the monetary policy, but should rather continue in estimating the economic benefits of having an immune central bank from political constraints or the costs of electoral induced monetary policies.

Although, the new wave of research of the relationship between electoral cycles and the monetary policies has shifted to the analysis of policy instruments (e.g. base rate) rather than policy outcomes (e.g. monetary aggregates), most of papers do not take into account two crucial facts about central bank's behavior: (i) it can have an asymmetric behavior depending on the proximity of elections; (ii) it may change its monetary policy stance over time. These facts have significant implications for the analysis of the central bank's reaction functions, which are rather dynamic than fixed. A recent contribution in this direction was made by Baxa, Horvath and Vasicek (2010) who estimated the reaction functions of the central banks in several inflation targeting countries based on the moment-based estimator in a time-varying parameter model with endogenous regressors.

Following the argument of regime switching behavior of the central banks depending on the proximity of elections, the monetary policy rule should rather be estimated in a non-linear setting instead of a linear one. Respectively, it will provide a better goodness of fit for the countries with politically sensitive central banks.

Last, but not least, the research on election induced monetary policies were mostly concentrated on developed economies (mostly USA) and pay less attention to developing countries. The main reason is the constraints related to data availability and quality, as well as short and very volatile time series. However, nowadays, many of these countries significantly increased the quality of their statistical databases, which made possible conducting research in these areas. Hence, it is worth estimating the sensitivity of monetary policies in these countries, where the issue of political independence of the central banks could be more stringent.

# Chapter 2: The Methodology

## 2.1 Introductory Remarks

This chapter outlines the theoretical and empirical methodological framework employed for testing the validity of Political Monetary Cycles hypothesis. Thus, it includes the theoretical description of OLS, 2SLS and 3SLS models which will be used in this research. Additionally, the non-linear model specification will be introduced in order to control for regime shifting behavior of politically influenced central banks.

## 2.2 Description of Econometric Models: OLS, 2SLS and 3SLS

The political monetary cycles hypothesis will be tested by comparing the regression results of three estimation techniques: (i) ordinary least squares (OLS), (ii) two-stage least squares (2SLS) and (iii) three-stage least squares (3SLS). Particularly, 2SLS model is used due to potential correlation between the explanatory variables and the error terms (endogeneity problem), which makes the OLS estimates biased and inconsistent. Additionally, 3SLS is used due to eventual non-diagonality of variance covariance matrix which hampers the parameters' efficiency, making the standard errors biased. Obviously, Hausman's Specification Test will help us to depict these problems and, thus, use the right estimation method.

The central banks' reaction functions for the analyzed countries could be estimated jointly via ordinary least squares (OLS) according to the formula:

$$i_i = \alpha_i + \pi_i \beta_i + Y_i \delta_i + u_i, \text{ where}$$

$\pi_i$  and  $Y_i$  – inflation and output gap of the  $i^{\text{th}}$  country and  $i = 1, 2, \dots, n, n - \#$  of countries

Additionally, the reaction function may contain an interest rate smoothing parameter to control for monetary policy inertia: the central bank spreads the shocks of new economic news through several periods of time in order to better anchor the expectations and prevent adverse policy shocks (increase in inflation or output decline). Hence, the inertial reaction function is obtained by adding the partial adjustment component to the original equation:

$$i_{it} = \alpha_{it} + \pi_{it}\beta_{it} + Y_{it}\delta_{it} + u_{it}$$

$$i_{it} = (1 - \rho)i_{it} + i_{it-1}$$

At the same time, following Rudebusch (2006), this policy gradualism which was strongly advocated by Rotemberg and Woodford (1999), Fuhrer (2000), Bernanke (2004) and others, may be spurious. The main reason is that the statistical significance of the interest rate smoothing parameter may be due to omissions of other persistent factors that shape the monetary policy. Hence, a better goodness of fit may be reached by estimating a non-inertial reaction function, but with serially correlated error terms. Such specification could be more realistic because it controls for other factors which cause the deviation of the monetary policy stance from the theoretical (e.g. data revisions, supply-side shocks etc). Therefore, the inertial reaction function is compared with the non-inertial one, but with serially correlated error terms:

$$i_i = \alpha_{it} + \pi_{it}\beta_{it} + Y_{it}\delta_{it} + u_{it}$$

$$u_{it} = (1 - \rho)u_{it} + u_{it-1}$$

Consequently, the decision in favor of inertial or non-inertial reaction function will be made according to the goodness of fit information criteria.

In fact, this is the simplest estimation method, which employs quite strong assumptions about no endogeneity and no autocorrelation. However, these could not be true due to the high probability that some explanatory variables from the central bank's reaction function are correlated with the error terms. In this case, OLS estimated are not consistent and biased. Therefore, in order to solve the endogeneity problem we can employ 2SLS.

2SLS can control for country specific shocks which enter the reaction function as error terms and which can be correlated with the explanatory variables. Additionally, there is a causality issue leading to a simultaneous bias: besides the fact that the central bank's policy rate may be shaped by the inflationary pressures and output gap, it can also influence these variable, though with a certain lag. Thus, without using instrumental variables, the OLS estimated parameters may be biased and inconsistent. In order to solve this issue, both determinants of monetary policy decisions (inflation and output gap) entering the central banks' reaction function will be estimated as endogenous

variables, being determined inside the system with the help of additional exogenous variables.

Hence, instead of univariate regression, simultaneous equation models will be employed. Thus, the current CPI ( $\pi_{it}$ ) will be regressed on its lagged values ( $\pi_{it-1}$ ) and the lagged values of the policy rate ( $i_{it-1}$ ), while the GDP gap ( $Y_{it}$ ) will be expressed as a function of its lagged values ( $Y_{it-1}$ ) and the industrial production index gap ( $X_4$ ).

According to the 2SLS methodology, in the first stage the endogenous variables are regressed on its determinants (1<sup>st</sup> stage) and, in the second stage, the obtained fitted values of endogenous variables are introduced into the central bank's reaction function (2<sup>nd</sup> stage). As a result, the new determinants of the central bank's policy rate are uncorrelated with the error term and have sufficient explanatory power. Theoretically, this estimation procedure can be expressed in the following way:

*The 1<sup>st</sup> stage:*

$$i_{it} = \alpha_0 + \rho_i i_{it-1} + \beta_{it} \pi_{it} + \delta_{it} Y_{it} + u_{it},$$

where  $\pi_{it}$  and  $Y_{it}$  are endogenous variables. In the 1<sup>st</sup> stage these are regressed on a set of exogenous variables which should be highly correlated with  $\pi_{it}$  and  $Y_{it}$ , but uncorrelated with  $u_{it}$ :

$$\pi_{it} = \alpha_0 + \alpha_1 \pi_{it-1} + \alpha_2 i_{it-1} + e_{it}$$

$$Y_{it} = \beta_0 + \beta_1 Y_{it-1} + \beta_2 X_4 + \mu_{it}$$

*The 2<sup>nd</sup> stage:*

In the 2<sup>nd</sup> stage, once the fitted values obtained from the 1<sup>st</sup> stage are not correlated with the error term, we may use OLS in order to regress the central bank's policy rate with the fitted values of these endogenous variables:

$$i_{it} = i_{it-1} \rho_i + \hat{\pi}_{it} \beta_{it} + \hat{Y}_{it} \delta_{it} + e_1$$

While 2SLS is a single equation model which is estimated in the 2<sup>nd</sup> stage by OLS it is vulnerable to potential biasness problem of the parameters' standard errors. Thus, in many cases, the inappropriate exogenous variables (instrumental variables) may generate significant efficiency loss of the 2SLS estimators. This could be the problem of

diagonality of variance covariance matrix of the error terms which may be solved by using Generalized Least Squares method instead of OLS.

In this case, Three-Stage Least Squares (3SLS) method can be used, which is somehow similar to the so-called Seemingly Unrelated Regression model (Baldagi, 2006) because it contains the assumption of contemporaneous correlation among residuals. In this case, the system will be estimated as follows:

$$\begin{bmatrix} y_1 \\ \vdots \\ y_N \end{bmatrix} = \begin{bmatrix} Z_1 & 0 & 0 \\ \vdots & \ddots & \vdots \\ 0 & 0 & Z_N \end{bmatrix} \begin{pmatrix} \phi_1 \\ \vdots \\ \phi_N \end{pmatrix} + \begin{pmatrix} u_1 \\ \vdots \\ u_N \end{pmatrix}$$

which can be written as:

$$y = Z\phi + u,$$

Where  $Z$  accounts for all exogenous and endogenous variables,  $\phi$  - a vector of regression coefficients of all variables and  $u$  has zero mean and the variance-covariance matrix is  $\Sigma \otimes I_T$ , implying some possible correlation among disturbances. Hence, this system is estimated using GLS:

$$\hat{\phi}_{GLS} = (Z^T (I_N \otimes X) [\Sigma^{-1} \otimes (X^T X)^{-1}] (I_N \otimes X^T) Z)^{-1}$$

We can simplify this formula and estimate  $\Sigma$  by getting the residuals after running 2SLS:

$$\hat{u}_i = y_i - Z_i \hat{\phi}_{i,2SLS} \text{ and } \hat{\Sigma} = |\hat{\sigma}_{ij}|, \quad \text{for } i, j = 1, 2, \dots, N$$

Finally, we get the 3SLS estimator:

$$\hat{\phi}_{3SLS} = (Z^T [\hat{\Sigma}^{-1} \otimes P_x] Z)^{-1} (Z^T [\hat{\Sigma}^{-1} \otimes P_x] y)$$

Therefore, if the system is properly identified, 3SLS is more efficient than 2SLS.

In our case, the 3SLS will be applied for the following system of equations which will be estimated jointly:

$$\begin{cases} i_{it} = \lambda_1 + \rho_i i_{it-1} + \beta_{it} \pi_{it} + \delta_{it} Y_{it} + u_{it} \\ \pi_{it} = \lambda_2 + \alpha_1 \pi_{it-1} + \alpha_2 i_{it-1} + e_{it} \\ Y_{it} = \lambda_3 + \beta_1 Y_{it-1} + \beta_2 X_4 + \mu_{it} \end{cases}$$

### 2.3 Hausman's specification test

For testing which estimation technique is more appropriate: OLS, 2SLS or 3SLS, Hausman's specification test will be used:

It tests the following hypotheses:

$H_0: E(u|X) = 0$  (no correlation between explanatory variable and the error term)

$H_1: E(u|X) \neq 0$  (the explanatory variable and the error term are correlated)

The test is calculated based on 2 estimators: (i)  $\widehat{\beta}_0$  is consistent and efficient under  $H_0$  and becomes inconsistent under  $H_1$ ; (ii)  $\widehat{\beta}_1$  is consistent under both hypotheses and inefficient under  $H_0$ . Thus, the first one is estimated with OLS or 3SLS while the second one – with 2SLS.

Hausman's specification test is calculated based on the vector of contrasts which is the difference between these 2 estimators according to formulas:

$\hat{q} = \hat{\beta}_1 - \hat{\beta}_0$ ,  $var(\hat{q}) = var(\hat{\beta}_1) - var(\hat{\beta}_0)$  (and  $m = \hat{q}^T var(\hat{q})^{-1} \hat{q}$  which converges to  $\chi_k^2$ , where k is the dimension of  $\beta$ ).

According to this test, if we cannot reject the null hypothesis about no correlation between explanatory variable and the error term there is no major difference between the parameters estimated with OLS and 2SLS. In this case, we should use OLS as it is unbiased, more efficient than 2SLS and easier to estimate. However, if we reject the null and find that the explanatory variable and the error term are correlated, we should use 2SLS which gives unbiased estimators. Moreover, we may prefer 3SLS over 2SLS, since it estimates the system jointly and generates more efficient parameters.

## 2.4 The Identification Problem

Since the estimation of the central bank's reaction function is based on a system of equations, in which the endogenous variables are defined within additional structural equations, it is necessary to check whether the system is identified or not. This is crucial for simultaneous equation models because an unidentified system may cause perfect multicollinearity when running 2SLS and/or 3SLS (Kelejian and Oates, 1989). Moreover, an under-identified model generates less meaningful results. According to Bekker and Wansbeek (2001), "Scientific conclusions drawn on the basis of such arbitrariness are in the best case void and in the worst case dangerous." Hence, in order to perform correctly these estimation methods, we need at least several excluded exogenous variables from the main (first) equation, which can be found in the 2<sup>nd</sup> and the 3<sup>rd</sup> equations.

Following Baltagi (2006), a necessary condition for identification of any structural equation is that the number of excluded exogenous variables from this equation are greater than or equal to the number of right hand side included endogenous variables. Let  $K$  be the number of exogenous variables in the system, then this condition requires  $k_2 \geq g_1$ , where  $k_2 = K - k_1$ , where  $k_1$  stands for the number of RHS exogenous variables.

In our case, the endogenous variables ( $g_1$ ) are the short-term interest rate ( $i_{it}$ ), inflation rate ( $\pi_{it}$ ) and output gap ( $Y_{it}$ ). The exogenous variables ( $K$ ) are the lagged short-term interest rate ( $i_{it-1}$ ), lagged inflation rate ( $\pi_{it-1}$ ), industrial producers prices index ( $X_2$ ) and the industrial production index gap ( $X_4$ ). Let us check, based on the **order condition of identification** whether the equations included in our system satisfy the requirement -  $k_1 \geq g_1$ .

$$i_{it} = \lambda_1 + \rho_i i_{it-1} + \beta_{it} \pi_{it} + \delta_{it} Y_{it} + u_{it}: 5 - 1 \geq 2 \text{ (over-identified)}$$

$$\pi_{it} = \lambda_2 + \alpha_1 \pi_{it-1} + \alpha_2 X_2 + e_{it}: 5 - 2 \geq 0 \text{ (over-identified)}$$

$$Y_{it} = \lambda_3 + \beta_1 Y_{it-1} + \beta_2 X_4 + \mu_{it}: 5 - 2 \geq 0 \text{ (over-identified)}$$

Hence, we can conclude that our system is over-identified. However, the order condition for identification is *necessary*, but *not sufficient* condition for identification. Thus, it is useful only when the condition is not satisfied. In our case, we have to



continue with the **rank condition for identification** in order to check for sure whether the system is identified.

In order to compute the rank condition for identification we rewrite our simultaneous equations model into the following form:

$$B y_t + \Gamma x_t = u_t,$$

where  $B y_t$  stands for endogenous variables and  $\Gamma x_t$  - for endogenous variables.

$$i_{it} - \beta_{it}\pi_{it} - \delta_{it}Y_{it} - \rho_i i_{it-1} - \lambda_1 = u_{it}$$

$$\pi_{it} - \alpha_1\pi_{it-1} - \alpha_2 X_2 - \lambda_2 = e_{it}$$

$$Y_{it} - \beta_1 Y_{it-1} - \beta_2 X_4 - \lambda_3 = \mu_{it}$$

Next, we construct the matrix A which comprises the coefficients of the endogenous (B) and exogenous variables ( $\Gamma$ ). A more detailed description about the methodology is provided by Baltagi (2006).

$$A = \begin{pmatrix} 1 & -\beta_{it} & -\delta_{it} & -\rho_i & -\lambda_1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & -\alpha_1 & -\alpha_2 & -\lambda_2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & -\beta_1 & -\beta_2 & -\lambda_3 \end{pmatrix}$$

In order to compute the rank condition for identification for each equation we have to multiply the matrix A with the transposed vectors of zero restrictions ( $\phi_1^T, \phi_2^T, \phi_3^T$ ) imposed for each equation, as follows:

$$\phi_1 = (0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1)$$

$$\phi_2 = (1, 0, 1, 1, 1, 0, 0, 0, 1, 1, 1)$$

$$\phi_3 = (1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0)$$

$$\mathbf{1^{st} equation: } A * \phi_1^T = \begin{pmatrix} 0 \\ -\alpha_1 - \alpha_2 - \lambda_2 \\ -\beta_1 - \beta_2 - \lambda_3 \end{pmatrix} \Rightarrow \text{rank} = 2 \geq 3 - 1 \text{ (just identified)}$$

$$\mathbf{2^{nd} equation: } A * \phi_2^T = \begin{pmatrix} 1 - \delta_{it} - \rho_i - \lambda_1 \\ 0 \\ 1 - \beta_1 - \beta_2 - \lambda_3 \end{pmatrix} \Rightarrow \text{rank} = 2 \geq 3 - 1 \text{ (just identified)}$$

**3<sup>rd</sup> equation:**  $A * \phi_3^T = \begin{pmatrix} 1 - \beta_{it} - \rho_i - \lambda_1 \\ 1 - \alpha_1 - \alpha_2 - \lambda_2 \\ 0 \end{pmatrix} \Rightarrow \text{rank} = 2 \geq 3 - 1 \text{ (just identified)}$

In conclusion, the simultaneous equations model is just identified which means that this specification is appropriate and we can continue with its estimation.

## 2.5 Discussion of Model Specification

The impact of electoral cycles on the monetary policies of analyzed countries will be tested via a non-linear reaction function, assuming a regime switching behavior depending on the elections' proximity. Hence, central banks' reactions to inflationary pressures and output gap will be compared between two different periods: electoral and non-electoral one. Thus, our model takes a non-linear form, by introducing the electoral and non-electoral regimes which are identified by a binary variable (E) standing for 1 for 4 quarters before the election date and 0 for normal times. The "electoral reaction function" is obtained by multiplying each variable with E, while the "non-electoral reaction function" – by multiplying each variable with (1 – E). Additionally, we compare the non-linear policy rule with partial adjustment:

$$\begin{cases} i_t = \alpha_1 + \rho i_{t-1} + \beta_1 \pi_t * E + \phi_1 (y_t - y_t^*) * E + u_{1t} \\ i_t = \alpha_2 + \rho i_{t-1} + \beta_2 \pi_t * (1 - E) + \phi_2 (y_t - y_t^*) * (1 - E) + u_{2t} \end{cases}$$

with the non-inertial reaction function with serially correlated error terms (Rudebusch, 2006):

$$\begin{cases} i_t = \alpha_1 + \beta_1 \pi_t * E + \phi_1 (y_t - y_t^*) * E + u_{1t-1} + e_{1t}, e_{1t} = \rho e_{1t-1} + u_{1t} \\ i_t = \alpha_2 + \beta_2 \pi_t * (1 - E) + \phi_2 (y_t - y_t^*) * (1 - E) + e_{1t}, e_{1t} = \rho e_{1t-1} + u_{1t} \end{cases}$$

where:

$i_t$  – short-term interest rate, as a proxy for the monetary policy stance

$\pi_t$  – current inflation ( $\pi_t$ )

$(y_t - y_t^*)$  – the difference between the current GDP ( $y_t$ ) and the potential one ( $y_t^*$ )

$E$  – a dummy variable which takes the value of 1 for electoral period (4 quarters before the election's day) and 0 for normal times.

The output gap will be estimated as a deviation of the current GDP from its potential level. The potential level is approximated using the Hodrick-Prescott filter (Hodrick and Prescott, 1997) with a standard smoothing parameter for quarterly time-series ( $\lambda = 1600$ ). Although, this approach of estimating the potential output suffers from the so-called end point bias, other flaws being well-documented by Harvey and Jaeger (1993), it has a wide application among researchers (Baxa, Horvath, Vasicek, 2011)<sup>1</sup>.

We expect that  $\beta_1$  is positive due to the central bank's commitment to ensure price stability (higher prices calls for tighter monetary policy) and  $\phi_1$  should also be positive due to the counter-cyclical nature of the monetary policy. The same holds true for parameters  $\beta_2$  and  $\phi_2$ . Since during electoral periods the central bank may become less inflation averse and postpone its counter-inflationary actions after elections, we expect  $\beta_1$ , which measures the degree of inflationary aversion of the monetary authority in the proximity of elections, to be lower than  $\beta_2$ . Additionally,  $\phi_1$ , which stands for the central banks' commitment to prevent the economy from overheating during electoral periods, is expected to be lower in comparison with  $\phi_2$ . Since this model is able to capture the non-linear behavior of monetary authorities influenced by electoral cycles, it has a higher goodness of fit and, respectively, lower errors, in comparison with the linear models.

For 2SLS and 3SLS, the central bank's reaction function will be estimated with the help of additional equations. Thus, in the case of inertial policy rule the system of equations is specified as follows:

$$\begin{aligned} i_t &= \alpha_0 + \rho i_{t-1} * E + \beta_1 \pi_t * E + \phi_1 (y_t - y_t^*) * E + \rho i_{t-1} * (1 - E) + \beta_2 \pi_t * (1 - E) \\ &\quad + \phi_2 (y_t - y_t^*) * (1 - E) + u_{1t} \\ \pi_t * E &= \gamma_0 + \gamma_1 \pi_{t-1} * E + \gamma_2 y_{t-1} * E + u_{2t} \\ \pi_t * (1 - E) &= \delta_0 + \delta_1 \pi_{t-1} * (1 - E) + \delta_2 y_{t-1} * (1 - E) + u_{3t} \\ (y_t - y_t^*) * E &= \theta_0 + \theta_1 (y_{t-1} - y_{t-1}^*) * E + \theta_2 IPI_t * E + u_{4t} \\ (y_t - y_t^*) * (1 - E) &= \mu_0 + \mu_1 (y_{t-1} - y_{t-1}^*) * (1 - E) + \mu_2 IPI_t (1 - E) + u_{5t} \end{aligned}$$

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<sup>1</sup> Following Billmeier (2004), The HP filter is a linear, two-sided filter that computes the smoothed series by minimizing the squared distance between trend ( $y_t^*$ ) and the actual series ( $y_t$ ) subject to a penalty on the second difference of the smoothed series:

$$\text{Min}_{y_t^*} \left\{ \sum_{t=1}^T (y_t - y_t^*)^2 + \lambda \sum_{t=2}^{T-1} [(y_{t+1}^* - y_t^*) - (y_t^* - y_{t-1}^*)]^2 \right\}$$

The penalty parameter,  $\lambda$ , controls the smoothness of the series by setting the ratio of the variance of the cyclical component and the variation in the second difference of the actual series. A higher value for  $\lambda$  implies a smoother trend (and, hence, more volatile gaps). In the extreme case of  $\lambda \rightarrow \infty$ , the trend is a straight line. The standard value in the literature is  $\lambda = 1600$  for quarterly data, which is also assumed as a base case in the analysis.

Where,  $i_t$  ,  $\pi_t * EL$  ,  $\pi_t * (1 - E)$  ,  $(y_t - y_t^*) * E$  and  $(y_t - y_t^*) * (1 - E)$  are endogenous variables, being determined inside the system, while the rest of variables are exogenous.

## 2.6 The Dataset

The dataset comprises quarterly time series of 4 macroeconomic indicators used for estimating the central bank's reaction functions for each of the 10 countries included in the group of advanced economies and other 10 countries considered emerging and developing economies. The indicators are: (i) Gross Domestic Product (GDP) which, in most cases, is expressed in logarithms<sup>2</sup>; (ii) Industrial Production Index (IIP); (iii) Consumer Price Index<sup>3</sup>; (iv) short-term interest rates, used as a proxy for the monetary policy stance. For proper estimation of the central bank's reaction function, the output gap has been computed as a deviation of the current GDP from its potential level approximated by its linear trend (HP filter). The data are collected from OECD statistical database, Eurostat and central banks' websites of the analyzed countries.

The electoral and non-electoral periods are approximated using a dummy variable standing for 1 for the period of 4 quarters before elections. The information about electoral years was taken from the following web portals: *electionresources.org* and *electionguide.org*. Given the assumption about politicians aiming at votes' maximization, there were used data about general direct elections.

The countries were divided into *advanced* and *developing economies* following the IMF classification. The list of countries from both categories, along with data descriptive statistics is presented in table 1 and table 2.

**Table 1:** Descriptive statistics for the data used for advanced economies

	GDP	IPI	CPI	STI	E
<b>1. Australia</b>					
<i>Mean</i>	-4.7811e-016	-4.5841e-016	75.649	8.9262	0.38710
<i>Min</i>	-6.0683	-5.5837	30.7	3.16	0
<i>Max</i>	4.7673	2.8263	116.7	19.47	1
<i>Std. Dev.</i>	1.7070	1.6526	23.756	4.5362	0.48906
<b>2. Canada</b>					

<sup>2</sup> Given the data availability constraints, for some countries q-o-q growth rates of real GDP was considered.

<sup>3</sup> Due to data constraints and the accuracy issues related to expected inflation, I use actual inflation data (Jeong and Maddala (1996), Evans and Honkapohja, (2001), Horvath and Mateju (2011)).

<i>Mean</i>	7.1627e-017	1.6045e-015	80.111	6.9006	0.30645
<i>Min</i>	-5.9484	-8.5366	39.8	0.38167	0
<i>Max</i>	3.3124	5.961	109.8	20.738	1
<i>Std. Dev.</i>	1.9277	2.6099	18.786	4.3196	0.46289
<b>3. Czech Republic</b>					
<i>Mean</i>	3.6752e-016	3.1852e-015	3.5747	4.9286	0.27586
<i>Min</i>	-0.032995	-13.607	-0.37383	1.2067	0
<i>Max</i>	0.043307	10.818	13.292	19.673	1
<i>Std. Dev.</i>	0.020301	5.2639	3.0625	4.5037	0.45085
<b>4. Denmark</b>					
<i>Mean</i>	-3.7680e-016	-1.6508e-015	2.4217	5.3625	0.34343
<i>Min</i>	-0.051802	-9.3617	0.93721	0.59227	0
<i>Max</i>	0.042619	7.1706	4.9898	14.053	1
<i>Std. Dev.</i>	0.016451	3.1476	0.95689	3.3130	0.47727
<b>5. Estonia</b>					
<i>Mean</i>	3.2289e-015	9.4739e-015	4.2958	3.841	0.25
<i>Min</i>	-16.736	-24.252	-1.9	1.13	0
<i>Max</i>	8.235	13.271	11.5	7.84	1
<i>Std. Dev.</i>	5.6321	8.9433	2.8477	1.862	0.43759
<b>6. Japan</b>					
<i>Mean</i>	8.9800e-016	1.9677e-015	101.08	0.24162	0.30769
<i>Min</i>	-9.0621	-21.981	99.6	0.001	0
<i>Max</i>	4.831	9.4385	103.6	2.1889	1
<i>Std. Dev.</i>	2.3311	5.3231	1.1791	0.34687	0.46513
<b>7. Norway</b>					
<i>Mean</i>	-1.1190e-016	-1.7903e-015	4.1658	8.1127	0.25197
<i>Min</i>	-0.073247	-6.2892	-1.3998	1.8933	0
<i>Max</i>	0.093476	4.1079	14.621	16.5	1
<i>Std. Dev.</i>	0.032806	1.8836	3.3887	4.3627	0.43586
<b>8. New Zealand</b>					
<i>Mean</i>	-1.1985e-016	3.0683e-015	90.480	7.3575	0.31818
<i>Min</i>	-3.7135	-5.4921	68	2.7251	0
<i>Max</i>	4.0708	3.8407	117.6	14.287	1
<i>Std. Dev.</i>	1.7764	2.2042	12.767	2.7511	0.46844
<b>9. Sweden</b>					
<i>Mean</i>	-1.4927e-016	-1.3136e-015	3.5206	6.7988	0.30252
<i>Min</i>	-0.04866	-13.338	-1.4166	0.16333	0
<i>Max</i>	0.054103	9.3374	11.301	15.133	1
<i>Std. Dev.</i>	0.019919	3.3848	3.2042	4.3939	0.46129
<b>10. USA</b>					
<i>Mean</i>	1.1804e-015	1.6485e-015	78.107	5.9073	0.256
<i>Min</i>	-5.4135	-9.0974	41	0.22000	0
<i>Max</i>	4.6617	6.1335	114.4	18.65	1
<i>Std. Dev.</i>	1.7607	2.4164	20.638	3.7831	0.43818

Source: OECD, Eurostat, individual central banks' websites

Table 2: Descriptive statistics for the data used for emerging and developing economies

	GDP	IPI	CPI	STI	E
<b>1. Bulgaria</b>					
<i>Mean</i>	2.2204e-016	1.0806e-014	6.1688	2.4329	0.25
<i>Min</i>	-0.044752	-10.828	-0.2	0.17	0
<i>Max</i>	0.061517	12.536	14.7	5.55	1
<i>Std. Dev.</i>	0.02235	5.6262	3.5637	1.5284	0.43759
<b>2. Brazil</b>					
<i>Mean</i>	2.9606e-017	-1.1842e-015	86.863	19.336	0.53333
<i>Min</i>	-0.0435	-15.246	51.6	8.75	0
<i>Max</i>	0.039051	8.809	129	46	1
<i>Std. Dev.</i>	0.015465	4.0203	24.178	8.6561	0.5031
<b>3. Hungary</b>					
<i>Mean</i>	0	8.6126e-016	9.861	11.741	0.24242
<i>Min</i>	-0.061488	-14.702	2.5372	0	0
<i>Max</i>	0.049784	13.232	30.377	33.367	1
<i>Std. Dev.</i>	0.022667	5.3652	7.3113	8.0447	0.43183
<b>4. Chile</b>					
<i>Mean</i>	3.5527e-016	-2.1316e-015	96.94	6.7147	0.26667
<i>Min</i>	-0.040053	-5.0134	71.9	0.43	0
<i>Max</i>	0.03938	6.3964	120.8	30.79	1
<i>Std. Dev.</i>	0.01881	2.7932	14.185	5.4067	0.44595
<b>5. Moldova</b>					
<i>Mean</i>	2.6456e-016	5.6125e-015	11.171	13.822	0.57447
<i>Min</i>	-0.052708	-19.611	-2.298	5	0
<i>Max</i>	0.043267	15.348	39.407	31.33	1
<i>Std. Dev.</i>	0.021839	7.905	7.5932	5.9173	0.49977
<b>6. Poland</b>					
<i>Mean</i>	1.8559e-016	-1.3787e-015	7.3301	11.59	0.47761
<i>Min</i>	-0.083734	-9.3825	0.30883	3.8233	0
<i>Max</i>	0.039376	10.909	32.792	29.71	1
<i>Std. Dev.</i>	0.026073	3.6448	7.5528	7.9996	0.50327
<b>7. Romania</b>					
<i>Mean</i>	1.8897e-016	5.3291e-015	14.342	15.781	0.33333
<i>Min</i>	-0.037745	-7.9906	3.2	2.87	0
<i>Max</i>	0.072402	11.952	49	52.95	1
<i>Std. Dev.</i>	0.024928	4.2895	12.485	12.776	0.47639
<b>8. Russia</b>					
<i>Mean</i>	-1.5118e-016	3.6283e-015	112.94	8.6511	0.2553
<i>Min</i>	-0.047862	-10.022	105.75	4.2333	0
<i>Max</i>	0.077259	7.4977	123.68	21.143	1

<i>Std. Dev.</i>	0.027404	3.8952	4.535	3.9006	0.44075
<b>9. Turkey</b>					
<i>Mean</i>	-8.2621e-016	3.6353e-015	18.377	23.122	0.27907
<i>Min</i>	-0.18349	-21.298	3.99	1.5	0
<i>Max</i>	0.070546	11.42	68.53	81.19	1
<i>Std. Dev.</i>	0.052131	6.2773	17.619	19.01	0.45385
<b>10. Slovenia</b>					
<i>Mean</i>	-3.2030e-015	3.5527e-016	3.58	3.9428	0.3
<i>Min</i>	-9.8048	-13.931	0	0.66217	0
<i>Max</i>	4.1802	13.717	7.5	8.6333	1
<i>Std. Dev.</i>	3.3523	5.7182	2.0293	2.294	0.4641

*Source: OECD, Eurostat, individual central banks' websites*

## 2.7 Concluding Remarks

In order to obtain unbiased and efficient parameters, several estimation methods will be employed. OLS will be used in case there will be no endogeneity problem as well as for the sake of comparison with other estimators. Otherwise, 2SLS will diminish the estimators' biasness with additional exogenous variables. However, due to efficiency loss suffered by this method, 3SLS will be preferred which, besides solving the endogeneity problem, will ensure unbiased standard errors due to its assumption of non-diagonality of variance-covariance matrix of the error terms.

Hence, the reaction function of the central bank will be estimated using univariate and multivariate models, where the inflation and output gap will be defined inside the system with the help of several relevant exogenous variables. Obviously, Hausman's Specification Test will be used for uncovering the endogeneity problem. Additionally, our simultaneous equations model will be tested for identification using order and rank conditions.

In order to better capture the regime switching behavior of the central bank depending on electoral cycles, the policy rule will be estimated within a non-linear setting. Thus, the central banks' aversion to inflation and its commitment to promote a counter-cyclical monetary policy are compared during electoral and non-electoral periods.

# Chapter 3: Discussion of Empirical Results

## 3.1 Introductory Remarks

This chapter provided a discussion about the main hypotheses used in our research, as well as about the empirical results derived with the methodology outlined in chapter 2. The regression outputs are compared among various specifications and models. Based on the Hausman's Specification Tests, the tests on equality of parameters and information criteria about the goodness of fit we choose the best option. Following these results, we make the final conclusions about the validity of political monetary cycles for each country.

## 3.2 The Main Hypotheses

Before providing the empirical results it is necessary to specify the hypotheses which will be tested in this research. These are:

1. The central banks are pressed by politicians to promote a looser monetary policy before elections, in order to ensure, on the short-run, a more dynamic output growth. Thus, the coefficient standing for inflation aversion and the counter-cyclical behavior in the central bank's reaction function will be lower during electoral periods in comparison with the normal times ( $\beta_1 < \beta_2$  and  $\phi_1 < \phi_2$ ). The evidence of such political monetary cycles was found by Boschen and Weise (2003), Grier (1987), and Haynes and Stone (1989). At the same time, these findings contrasted with that of Alesina and Roubini (1992), Beck (1987), Golden and Poterba (1980), and Leertouwer and Maier (2001).

2. The influence of electoral cycles on the monetary policy is less observed in advanced economies and is more persistent in emerging and developing countries. This could be due to a higher degree of independence and, thus, reputation, enjoyed by the first ones (Mishkin and Westelius (2006)). In this case, the discrepancy between the reaction function coefficients is much lower between the two sets of countries and the number of developing countries where PMC are found is higher than that of advanced economies. This hypothesis was tested and confirmed by Alpanda and Honig (2007),



who found no evidence of political monetary cycles in advanced countries, but found strong evidence in developing countries.

3. In countries where the evidence of electoral induced monetary policy is more persistent the central banks have a lower reputation, which imply negative repercussions on the monetary policy efficiency. Particularly, these economies suffer from inflation bias as the central bank cannot anchor the inflationary expectations, while the monetary policy transmission is much slower. This hypothesis refers to the reputational models developed by Kydland and Prescott (1977), Calvo (1978) and Barro and Gordon (1983) on the time-inconsistency problem and Blinder (1998) and Mishkin and Westelius (2006) on the importance of central bank independence in reducing this problem. Thus, we will test whether the inflation volatility is higher in countries with PMC in comparison with the rest of the sample.

4. In countries with political monetary cycles, the inflation tends to be higher around elections in comparison with the normal times. This is the direct outcome of easier monetary policy implemented during electoral periods under the pressures of incumbent politicians in order to boost the economy. This hypothesis was confirmed by Grier (1989), Klein (1996), Alesina and Rosenthal (1995), Drazen (2001).

Full regression outputs are presented in Annex B, while the table 3 and table 5 synthesize the estimated coefficients standing for central banks' inflation aversion during electoral ( $\beta_1$ ) and non-electoral periods ( $\beta_2$ ) and their counter cyclical behavior during electoral ( $\phi_1$ ) and non-electoral periods ( $\phi_2$ ). Although, the Hausman Test rejected the null hypothesis of no endogeneity for each estimated equation and revealed that 3SLS is the most efficient and unbiased estimator, the results for OLS and 2SLS are also included for comparison reasons. Additionally, for countries where the presence of electoral monetary cycles was confirmed empirically, an additional test for equality of estimated parameters was run by applying linear restrictions. The test results are included in the table 3 and table 5, below each country where evidence of PMC was found.

### **3.3 How Politically Sensitive are the Central Banks from Advanced Economies?**

The estimated central banks' reaction functions, using the inertial Taylor rule, for the set of advanced economies rejects the hypothesis of political monetary cycles. Following the Hausman's Specification Test which revealed the biasness and inconsistency of OLS estimates we resorted to simultaneous equation models. Particularly, due to substantial efficiency gains, 3SLS is preferred in comparison with 2SLS (table 3).

**Table 3: OLS, 2SLS and 3SLS Estimation Results of Central Banks` Reaction Functions in Advanced Economies** ( $\beta_1$  and  $\phi_1$  are the coefficients for the reaction of monetary policy to inflation and output gap in electoral periods;  $\beta_2$  and  $\phi_2$  – measure the same reaction in non-electoral periods).

	OLS				2SLS				3SLS			
	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$
<b>Czech Republic</b>	0.4681*** (0.1428)	0.1731* (0.0889)	31.5072 (19.1650)	1.8779 (8.2708)	0.7507*** (0.1836)	0.3081** (0.1255)	-0.6564 (23.6167)	-9.7201 (10.6800)	<b>0.6365***</b> <b>(0.1572)</b>	<b>0.2312**</b> <b>(0.1053)</b>	<b>12.4669</b> <b>(20.0156)</b>	<b>-3.9163</b> <b>(9.0635)</b>
<b>Denmark</b>	0.2530* (0.1354)	0.1294 (0.1012)	15.8420 (10.3755)	16.2402 (5.81614)	0.3059* (0.1688)	0.1502 (0.1138)	23.0576 (18.1778)	16.0934** (7.1502)	<b>0.2813*</b> <b>(0.1616)</b>	<b>0.1258</b> <b>(0.1085)</b>	<b>24.6100</b> <b>(17.4341)</b>	<b>16.9496**</b> <b>(6.8170)</b>
<b>Norway</b>	0.0783 (0.0477)	0.0699 (0.0468)	8.0930* (4.2503)	4.0005 (3.0146)	0.0808 (0.0495)	0.0567 (0.0532)	4.2534 (4.6477)	5.5829* (3.3137)	<b>0.0734</b> <b>(0.0466)</b>	<b>0.0575</b> <b>(0.0500)</b>	<b>4.1471</b> <b>(4.4678)</b>	<b>5.7984*</b> <b>(3.1323)</b>
<b>Sweden</b>	0.1520 (0.1191)	0.0731 (0.0532)	-16.086** (7.9992)	16.5098*** (5.5123)	-0.0485 (0.1584)	0.0892 (0.0649)	-0.3725 (10.1299)	14.3196** (6.8679)	<b>0.0618</b> <b>(0.1487)</b>	<b>0.0789</b> <b>(0.0600)</b>	<b>-3.6633</b> <b>(9.6191)</b>	<b>14.5930**</b> <b>(6.3665)</b>
<b>Australia</b>	-0.0128* (0.0066)	-0.013** (0.006)	0.2165*** (0.0804)	0.1965** (0.0763)	-0.0108 (0.0069)	-0.0118* (0.0069)	0.1047 (0.1043)	0.3159*** (0.1043)	<b>-0.018***</b> <b>(0.0062)</b>	<b>-0.017***</b> <b>(0.0062)</b>	<b>0.1365</b> <b>(0.0976)</b>	<b>0.2803***</b> <b>(0.0966)</b>
<b>Canada</b>	-0.0189* (0.0099)	-0.0172 (0.0105)	0.2659** (0.1177)	0.2309*** (0.0501)	-0.0178* (0.0099)	-0.0160 (0.0106)	0.3032** (0.1383)	0.2845*** (0.0568)	<b>-0.025***</b> <b>(0.0094)</b>	<b>-0.0234**</b> <b>(0.0099)</b>	<b>0.3201**</b> <b>(0.1299)</b>	<b>0.2791***</b> <b>(0.0541)</b>
<b>Japan</b>	0.0198 (0.0125)	0.0204 (0.0125)	0.0101 (0.0074)	0.0138 (0.0096)	0.0355** (0.0160)	0.0359** (0.016)	0.0073 (0.0085)	0.0473*** (0.0148)	<b>0.0134</b> <b>(0.0129)</b>	<b>0.0141</b> <b>(0.0129)</b>	<b>0.0028</b> <b>(0.0067)</b>	<b>0.0379***</b> <b>(0.0134)</b>
<b>New Zealand</b>	-0.0126 (0.0086)	-0.0100 (0.0075)	-0.0189 (0.0899)	0.2395*** (0.0489)	-0.0105 (0.0090)	-0.0078 (0.0081)	0.0816 (0.1403)	0.2937*** (0.0563)	<b>-0.0174**</b> <b>(0.0082)</b>	<b>-0.0129*</b> <b>(0.0074)</b>	<b>0.0445</b> <b>(0.1283)</b>	<b>0.2600***</b> <b>(0.0525)</b>
<b>USA</b>	-0.032*** (0.0105)	-0.034*** (0.010)	0.1020 (0.1558)	0.2009** (0.0778)	-0.035*** (0.0107)	-0.038*** (0.0103)	-0.1673 (0.194)	0.2313** (0.0957)	<b>-0.028***</b> <b>(0.0099)</b>	<b>-0.031***</b> <b>(0.0096)</b>	<b>-0.2738*</b> <b>(0.1843)</b>	<b>0.2093**</b> <b>(0.0886)</b>
<b>Estonia</b>	-0.0217 (0.1788)	0.1012** (0.0387)	0.0639 (0.0995)	0.0308 (0.0255)	-0.3684 (0.5160)	0.1092** (0.0539)	0.2574 (0.2829)	0.032 (0.0366)	<b>-0.1635</b> <b>(0.4511)</b>	<b>0.0695</b> <b>(0.0480)</b>	<b>0.1456</b> <b>(0.2474)</b>	<b>0.0689**</b> <b>(0.0322)</b>

Source: Author's computations

Note: The preferred specification is marked with bold

It is worth pointing out that these results are derived from a central bank's reaction function with an interest rate smoothing parameter which controls for the so-called monetary policy inertia. Thus, it is assumed that the monetary policy reaction to new economic news is distributed over many periods of time. Hence, the policy rule contains the following partial adjustment component:  $i_t = (1 - \rho)i_t + \rho i_{t-1}$ . However, if we estimate a non-inertial reaction function we find more evidence about political monetary cycles (Table 4).

**Table 4: 3SLS Estimation Results of Non-Inertial Central Banks' Reaction Functions in Advanced Economies** ( $\beta_1$  and  $\phi_1$  are the coefficients for the reaction of monetary policy to inflation and output gap in electoral periods;  $\beta_2$  and  $\phi_2$  – measure the same reaction in non-electoral periods).

	3SLS			
	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$
<b>Czech Republic</b>	1.5079*** (0.1608)	1.8988*** (0.2455)	-73.2573 (55.3729)	-104.25*** (26.0122)
<b>Denmark</b>	1.4761*** (0.4581)	1.2709*** (0.4090)	9.7908 (69.3844)	2.4339 (27.4238)
<b>Norway</b>	0.8849*** (0.0906)	1.1459*** (0.0779)	8.8463 (14.2551)	14.5934 (10.2848)
<b>Sweden</b>	1.3128*** (0.0943)	1.3326*** (0.0900)	-33.3797 (20.8455)	-35.8248** (15.9803)
<b>Australia</b>	-0.1541*** (0.0115)	-0.1616*** (0.0108)	-0.1564 (0.2604)	-0.3627 (0.2611)
<b>Canada</b>	-0.2024*** (0.0094)	-0.1962*** (0.0098)	0.0364 (0.2632)	0.0182 (0.1190)
<b>Japan</b>	0.0697** (0.0329)	0.0707** (0.0327)	-0.0054 (0.0178)	0.0596* (0.0317)
<b>New Zealand</b>	-0.1254*** (0.0187)	-0.1370*** (0.0182)	-1.618*** (0.3689)	-0.0358 (0.1614)
<b>USA</b>	-0.1442*** (0.0102)	-0.1482*** (0.0095)	-0.4857* (0.2867)	0.3293** (0.1497)
<b>Estonia</b>	0.8539*** (0.2719)	0.5581*** (0.0799)	-0.5042** (0.2158)	-0.2734*** (0.0441)

Source: Author's computations

Note: With the red fond are marked countries were PMC are statistically significant.

Thus, we can notice that the evidence about the PMC is highly sensitive to model specification. It calls for a careful and robust analysis of the right model in terms of theoretical and econometric principles. This finding is corroborated by Belke and Potrafke (2009) who argue that the evidence about ideology induced monetary policy is present only in the model without lagged short-term nominal interest rate, while it disappears whenever the regression includes this autoregressive component.

However, such a simple estimation of the reaction function cannot be adequate given the omitted variable bias which makes the estimated coefficients irrelevant. Thus, following Rudebusch (1995), central banks tend to adjust their policy interest rates in sequences of relatively small steps. Additionally, Ben Bernanke (2004), argued that

central banks use partial adjustment and monetary policy inertia intrinsically. Hence, the reaction functions must be enriched with interest rate smoothing parameters to measure the speed of monetary policy adjustment. Moreover, according to Rudebusch (2006), this estimation method ensures a much better fit and a greater explanatory power in comparison with the non-adjustment model. One of the main arguments in favor of monetary policy inertia is the possibility of the central bank to move and manage expectations and, thus, control for macroeconomic fluctuations. Therefore, partial adjustment can be optimal if the private sector is forward looking and the central bank is fairly committed to a gradual policy rule. These arguments are supported by the success of estimated inertial reaction function in fitting the real data (Rotemberg and Woodford, 1999 and Fuhrer, 2000).

At the same time, the argument that central banks intrinsically resort to monetary policy gradualism, supported by Bernanke (2004), was opposed by Rudebusch (2002b, 2006). He argued that the monetary policy rule estimates are misleading and provide just the illusion of monetary policy inertia. It means that usually the desired policy rate may depend on some other factors than output gap and inflation which could result in some spurious finding of partial adjustment. In other words, it is very hard to distinguish between a reaction function of a central bank which follows partial adjustment and the one with no policy inertia but where the central bank deviate from the rule in response to other factors. Therefore, instead of monetary policy gradualism hypothesis, Rudebusch (2006) proposes a different explanation of central banks' deviation from its policy rule: incomplete description of the monetary policy. This issue can be controlled by estimating a non-inertial reaction function of the central bank with serially correlated error terms (which are able to capture other factors which in some periods may cause the monetary authority to deviate from the regular reaction function).

In light of this academic debate between the proponents of intrinsic policy gradualism and those of partial adjustments, we compare the results obtained from inertial reaction and a non-inertial one with serially correlated errors, estimated with 3SLS. This estimation method has been chosen due to its efficiency gains compared to the 2SLS (table 5).

**Table 5: 3SLS Estimation Results of Inertial and Non-Inertial Central Banks' Reaction Functions for Advanced Economies** ( $\beta_1$  and  $\phi_1$  are the coefficients for the reaction of monetary policy to inflation and output gap in electoral periods;  $\beta_2$  and  $\phi_2$  – measure the same reaction in non-electoral periods).

	Inertial Model with no serially correlated errors				Non-inertial model with serially correlated errors			
	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$
<b>Czech Republic</b>	0.6365*** (0.1572)	0.2312** (0.1053)	12.4669 (20.0156)	-3.9163 (9.0635)	1.3721*** (0.0709)	1.3183*** (0.1457)	-44.5503* (24.9771)	-42.1286*** (12.9791)
<b>Denmark</b>	0.2813* (0.1616)	0.1258 (0.1085)	24.6100 (17.4341)	16.9496** (6.8170)	1.6505*** (0.4296)	1.5129 *** (0.3975)	14.2221 (62.1332)	-8.4893*** (26.8235)
<b>Norway</b>	0.0734 (0.0466)	0.0575 (0.0500)	4.1471 (4.4678)	5.7984* (3.1323)	0.8895*** (0.0864)	1.1307*** (0.0767)	4.0725*** (13.5993)	16.1717*** (9.8138)
					F(1,606) = 7.00815 [0.0083]		F(1,606) = 0.511711 [0.4747]	
<b>Sweden</b>	0.0618 (0.1487)	0.0789 (0.0600)	-3.6633 (9.6191)	14.5930** (6.3665)	1.2999*** (0.0898)	1.3569*** (0.0825)	-30.5906*** (19.1425)	-48.0732** (14.7362)
					F(1,566) = 0.360166 [0.5487]			
<b>Australia</b>	-0.018*** (0.0062)	-0.017*** (0.0062)	0.1365 (0.0976)	0.2803*** (0.0966)	-0.161*** (0.0105)	-0.1656*** (0.0098)	-0.2586 (0.2359)	-0.2451 (0.2344)
<b>Canada</b>	-0.025*** (0.0094)	-0.0234** (0.0099)	0.3201** (0.1299)	0.2791*** (0.0541)	-0.201*** (0.0081)	-0.1950*** (0.0085)	0.2351 (0.2349)	0.0272 (0.1015)
<b>Japan</b>	0.0134 (0.0129)	0.0141 (0.0129)	0.0028 (0.0067)	0.0379*** (0.0134)	0.0464** (0.0226)	0.0474** (0.0225)	-0.0175 (0.0129)	0.0642*** (0.0217)
<b>New Zealand</b>	-0.0174** (0.0082)	-0.0129* (0.0074)	0.0445 (0.1283)	0.2600*** (0.0525)	-0.118*** (0.0168)	-0.1285*** (0.0163)	-1.017*** (0.3525)	-0.0352 (0.1446)
<b>USA</b>	-0.028*** (0.0099)	-0.031*** (0.0096)	-0.2739 (0.1843)	0.2092** (0.0886)	-0.144*** (0.0094)	-0.1507*** (0.0089)	-0.6427** (0.2712)	0.2099 (0.1342)
							F(1,596) = 7.43334 [0.0066]	
<b>Estonia</b>	-0.1635 (0.4511)	0.0695 (0.0480)	0.1456 (0.2474)	0.0689** (0.0322)	0.8838*** (0.2440)	0.5537*** (0.0715)	-0.543*** (0.1939)	-0.2653*** (0.0412)
							F(1,211) = 2.05383 [0.1533]	

Source: Author's computations

Note: The parameters obtained from non-inertial model with serially correlated errors are marked with bulk due to better goodness of fit. With the red font are marked countries were PMC are statistically significant and the F-tests rejecting the null hypothesis of equality of parameters.

The estimation results reveal a much better goodness of fit for the non-inertial reaction functions with serially correlated error terms. This model expresses much better the behavior of central banks in advanced economies and provides a more efficient estimates then the inertial model. Hence, the final model specification used for testing for politically monetary cycles and to which we give our final preference is the **non-inertial reaction function with serially correlated error terms, estimated with 3SLS (GLS)**.

According to this specification, regime switching behavior of the central bank is found in 3 out of 10 advanced economies. However, only in 2 of these countries the test on equality of reaction parameters to inflation and output gap in electoral and non-electoral years was strongly rejected. Hence, the countries were PMC are statistically significant are: Norway and USA (marked with red font in table 5).

In the case of Norway, inflation aversion proves to be lower during electoral periods ( $\beta_1 < \beta_2$ ), while the test on equality of parameters was rejected ( $F(1,606) = 7.00815$  [0.0083]). It means that the central bank promotes a looser monetary policy before elections in order to stimulate output on the short term and, in this way, buy votes. At the same time, the counter-cyclical behavior of the central bank appears to be milder during electoral periods since its reaction to output gap is lower in comparison to normal times ( $\phi_1 < \phi_2$ ).

A similar regime switching behavior in electoral and non-electoral periods is found for USA. Thus, the estimated 3SLS coefficients for FED response to economic cycles' fluctuations suggest that the central bank is pro-cyclical before elections. The discrepancy appears to be quite strong and it survives the test for equality of parameters ( $F(1,596) = 7.43334$  [0.0066]) and serves as a robust evidence of the presence of electoral induced monetary policy in USA. At the same time, during non-electoral periods, the central bank is counter-cyclical: the monetary policy gets tighter in response to output gap growth. This finding is consistent with other papers which did not reject the hypothesis of political monetary cycles for US (Golden & Poterba (1980), Paldam (1979, 1981), Grier (1989) and Klein (1996)), revealing the vulnerability of FED to political pressures.

### **3.4 How Politically Sensitive are the Central Banks from Developing Economies?**

As in the case of advanced economies, the most efficient estimates are derived from 3SLS which control for the bias problem associated with OLS. Additionally, it appears to be more efficient than the 2SLS as it takes into account the non-diagonality of variance covariance matrix by performing generalized least squares.

Hence, based on 3SLS estimation results, we can notice that regime switching behavior of the central banks was found in 5 out of 10 countries, but only in 3 countries the test for equality of parameters was rejected.

**Table 6: OLS, 2SLS and 3SLS Estimation Results of Central Banks' Reaction Functions in Advanced Economies** ( $\beta_1$  and  $\phi_1$  are the coefficients for the reaction of monetary policy to inflation and output gap in electoral periods;  $\beta_2$  and  $\phi_2$  – measure the same reaction in non-electoral periods).

	OLS				2SLS				3SLS			
	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$
<b>Moldova</b>	0.2217*** (0.0388)	0.1730** (0.0841)	18.9791** (8.5757)	-7.5864 (26.0650)	0.2430*** (0.0645)	0.3064 (0.2266)	6.8459 (15.9246)	-56.2273 (85.5965)	<b>0.2671***</b> <b>(0.0446)</b>	<b>0.3434*</b> <b>(0.1807)</b>	9.2700 (12.4673)	-47.3013 (67.7513)
									F(1,211) = 0.0476006 [0.8275]			
<b>Russia</b>	0.2611*** (0.0559)	0.2438*** (0.0561)	-14.1997 (9.0176)	-3.8486 (6.4959)	0.4002** (0.1701)	0.3917** (0.1726)	-17.2246 (11.9585)	-11.1145 (10.6696)	<b>0.2852***</b> <b>(0.0611)</b>	<b>0.2706***</b> <b>(0.0615)</b>	<b>-16.324**</b> <b>(8.2118)</b>	<b>-2.5889</b> <b>(6.1135)</b>
									F(1,211) = 6.2971 [0.0128]			
<b>Brazil</b>	-0.0868** (0.0405)	-0.0674 (0.0428)	109.025* (64.4615)	-27.5002 (67.2874)	0.1307 (0.3616)	0.1910 (0.2616)	21.2490 (161.530)	110.297 (416.167)	<b>-0.0723**</b> <b>(0.0359)</b>	<b>-0.0547</b> <b>(0.0377)</b>	27.8597 (70.2939)	-8.6684 (66.8306)
									F(1,276) = 0.488802 [0.4851]			
<b>Chile</b>	-0.156*** (0.0475)	-0.156*** (0.0453)	12.8231 (55.7594)	107.154*** (28.2841)	-0.1059 (0.0758)	-0.1127 (0.0978)	24.6551 (100.555)	96.352** (42.0651)	<b>-0.165***</b> <b>(0.0461)</b>	<b>-0.163***</b> <b>(0.0436)</b>	<b>-10.6939</b> <b>(56.7159)</b>	<b>112.176***</b> <b>(30.1377)</b>
<b>Hungary</b>	0.3505 (0.4678)	0.4982*** (0.1465)	26.9608 (37.7151)	-4.8891 (19.8818)	0.6141 (0.6584)	0.4140** (0.1697)	-5.1744 (64.9224)	-25.36 (27.6176)	<b>0.5694</b> <b>(0.6013)</b>	<b>0.4096***</b> <b>(0.1574)</b>	<b>-2.8907</b> <b>(59.3319)</b>	<b>-21.4077</b> <b>(25.6418)</b>
<b>Poland</b>	0.1983*** (0.0598)	0.1033* (0.0592)	37.3643*** (8.1029)	8.5507 (7.1608)	0.1937*** (0.0705)	0.0534 (0.0626)	40.5447*** (9.7440)	9.9617 (7.8278)	<b>0.1846***</b> <b>(0.0575)</b>	<b>0.0441</b> <b>(0.0558)</b>	<b>39.0564***</b> <b>(7.9680)</b>	<b>7.6401</b> <b>(6.3055)</b>
<b>Turkey</b>	-0.2006** (0.0987)	0.2877*** (0.0538)	-9.8110 (27.1027)	21.7825*** (7.0043)	0.1730 (1.3602)	-0.8745 (3.0111)	120.405 (403.989)	30.6468 (37.5086)	<b>-0.1907</b> <b>(0.1304)</b>	<b>0.2952***</b> <b>(0.0607)</b>	<b>16.6842</b> <b>(33.6385)</b>	<b>22.1912***</b> <b>(6.7100)</b>
									F(1,191) = 8.29889 [0.0044]		F(1,191) = 11.3442 [0.0009]	
<b>Slovenia</b>	0.1710 (0.1022)	0.0566 (0.0988)	0.0678** (0.0317)	0.0799 (0.0604)	0.4162** (0.1808)	0.1235 (0.1534)	0.0257 (0.0417)	0.0969 (0.0909)	<b>0.5608***</b> <b>(0.1485)</b>	<b>0.0511</b> <b>(0.1242)</b>	<b>0.0143</b> <b>(0.0333)</b>	<b>0.1813**</b> <b>(0.0726)</b>
<b>Romania</b>	0.3248** (0.1365)	0.5293*** (0.1821)	20.1147 (23.89)	54.2931* (30.7912)	0.2328 (0.1502)	0.645*** (0.2236)	21.9693 (24.555)	76.4174** (33.1002)	<b>0.2628**</b> <b>(0.1308)</b>	<b>0.7505***</b> <b>(0.1899)</b>	<b>13.4291</b> <b>(20.6172)</b>	<b>81.680***</b> <b>(28.8633)</b>
									F(1,211) = 3.34721 [0.0687]			
<b>Bulgaria</b>	0.0743 (0.0588)	-0.0294 (0.0588)	31.077** (12.8896)	32.724*** (9.5572)	0.1247 (0.0843)	0.1992 (0.1536)	12.2850 (21.6528)	6.9441 (19.5451)	<b>0.0936</b> <b>(0.0666)</b>	<b>0.1092</b> <b>(0.1289)</b>	<b>21.8505</b> <b>(17.1414)</b>	<b>21.9582</b> <b>(15.5027)</b>

Source: Author's computations

Note: The parameters with highlighted with bulk are considered the most efficient. With the red font are marked countries were PMC are statistically significant.



Thus, in Russia the monetary policy is strongly pro-cyclical during electoral periods (the interest rates decrease in response to higher output). In Romania the central bank becomes less inflation averse before elections in comparison with non-electoral periods. In Turkey, the reaction function is very different in the proximity of elections from normal times. Thus, it is counter-cyclical and anti-inflationary during non-electoral periods, while before elections it deviates from this rule and, apparently, becomes discretionary, as neither the reaction parameter to inflation, nor to output gap is statistically significant (table 6).

For the sake of comparison, table 7 presents the 3SLS estimation output of non-inertial reaction function of the central bank: the monetary policy is solely explained by CPI and output gap, while interest rate smoothing parameter was subtracted.

**Table 7: 3SLS Estimation Results of Non-Inertial Central Banks' Reaction Functions in Emerging and Developing Economies** ( $\beta_1$  and  $\phi_1$  are the coefficients for the reaction of monetary policy to inflation and output gap in electoral periods;  $\beta_2$  and  $\phi_2$  – measure the same reaction in non-electoral periods).

	3SLS			
	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$
<b>Moldova</b>	0.7259*** (0.0913)	0.9039*** (0.1827)	9.1864 (33.9895)	-372.55*** (93.2879)
<b>Russia</b>	1.4114*** (0.1055)	1.3943*** (0.1039)	-66.9607** (27.3938)	-39.9472* (21.1775)
<b>Brazil</b>	-0.2440*** (0.0353)	-0.2583*** (0.0379)	-32.5304 (92.2475)	-91.9458 (75.2924)
<b>Chile</b>	-0.3016*** (0.0401)	-0.2894*** (0.0388)	-45.313 (57.4074)	145.739*** (34.252)
<b>Hungary</b>	1.0594*** (0.1205)	1.0099*** (0.0558)	-38.1496 (46.167)	-13.1263 (28.5974)
<b>Poland</b>	1.0605*** (0.0515)	1.1220*** (0.0713)	124.730*** (20.7705)	23.3294 (19.8531)
<b>Turkey</b>	0.8486*** (0.0513)	1.1176*** (0.0646)	148.385** (60.4906)	2.6253 (18.564)
<b>Slovenia</b>	1.2301*** (0.1083)	1.1681*** (0.0918)	0.0050 (0.0684)	-0.2146** (0.1066)
<b>Romania</b>	0.894*** (0.0465)	0.9635*** (0.0503)	-3.7801 (25.3655)	104.08*** (35.6671)
<b>Bulgaria</b>	0.0834 (0.0787)	0.0601 (0.0903)	47.1821*** (17.3178)	49.5571*** (12.9896)

Source: Author's computations

Note: With the red fond are marked countries were PMC are statistically significant.

We can notice that the PMC hypothesis was not rejected for 5 out of 10 countries, where electoral induced monetary policies were found after estimating the inertial reaction function. However, due to reasons mentioned in the previous sub-chapter, such specification, most probably, suffers of omitted variable bias, as policy gradualism or other shocks impacting the monetary policy stance are not taken into account. The estimation of the non-inertial model is rather useful for analyzing the sensitivity of estimation results to the inclusion/exclusion of partial adjustment component.

Following the discussion from the previous sub-chapter, the inertial reaction function estimates are compared to those obtained from non-inertial model but with serially correlated error terms, both estimated with 3SLS due to reasons mentioned earlier. Based on the goodness of fit we can select which specification is better.

**Table 8: 3SLS Estimation Results of Inertial and Non-Inertial Central Banks' Reaction Functions for Emerging and Developing Economies** ( $\beta_1$  and  $\phi_1$  are the coefficients for the reaction of monetary policy to inflation and output gap in electoral periods;  $\beta_2$  and  $\phi_2$  – measure the same reaction in non-electoral periods).

	Inertial Model with no serially correlated errors				Non-inertial model with serially correlated errors			
	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$	$\beta_1$	$\beta_2$	$\phi_1$	$\phi_2$
<b>Moldova</b>	0.2671*** (0.0446)	0.3434* (0.1807)	9.2700 (12.4673)	-47.3013 (67.7513)	0.8616*** (0.0877)	1.2478*** (0.1543)	-56.3229*** (28.6501)	-396.479*** (63.2756)
					F(1,206) = 11.5354 [0.0008]			
<b>Russia</b>	0.2852*** (0.0611)	0.2706*** (0.0615)	-16.324** (8.2118)	-2.5889 (6.1135)	0.4361*** (0.1189)	0.4449*** (0.1159)	0.2161 (30.2079)	-35.7526 (22.2444)
			F(1,211) = 6.2971 [0.0128]					
<b>Brazil</b>	-0.0723** (0.0359)	-0.0547 (0.0377)	27.8597 (70.2939)	-8.6684 (66.8306)	-0.2218*** (0.0328)	-0.2374*** (0.0349)	59.6528 (85.7719)	-117.695* (70.4857)
<b>Chile</b>	-0.165*** (0.0461)	-0.163*** (0.0436)	-10.6939* (44.5714)	112.176*** (30.1377)	-0.2739*** (0.0374)	-0.2626*** (0.0362)	-21.3643 (54.3230)	167.445*** (31.5352)
<b>Hungary</b>	0.5694 (0.6013)	0.4096*** (0.1574)	-2.8907 (59.3319)	-21.4077 (25.6418)	0.8982*** (0.1298)	0.9533*** (0.0558)	42.352 (51.6029)	-36.2248 (30.0458)
					F(1,301) = 0.255855 [0.6134]			
<b>Poland</b>	0.1846*** (0.0575)	0.0441 (0.0558)	39.0564*** (7.9680)	7.6401 (6.3055)	1.0788*** (0.0606)	1.1064*** (0.0757)	116.675*** (22.6208)	24.1044 (20.0961)
					F(1,306) = 0.130851 [0.7178]			
<b>Turkey</b>	-0.1907 (0.1304)	0.2952*** (0.0607)	16.6842 (33.6385)	22.1912*** (6.7100)	0.8172*** (0.0414)	1.0616*** (0.0474)	169.404*** (46.9386)	43.2221*** (15.4881)
	F(1,191) = 8.29889 [0.0044]		F(1,191) = 11.3442 [0.0009]		F(1,186) = 19.7474 [0.0000]			
<b>Slovenia</b>	0.5608*** (0.1485)	0.0511 (0.1242)	0.0143 (0.0333)	0.1813** (0.0726)	0.9337*** (0.1409)	1.2761*** (0.1006)	0.0643 (0.0803)	-0.1595** (0.0656)
					F(1,171) = 0.618087 [0.4328]			
<b>Romania</b>	0.2628** (0.1308)	0.7505*** (0.1899)	13.4291 (20.6172)	81.680*** (28.8633)	0.9894*** (0.0406)	1.0231*** (0.0416)	39.9383** (17.9821)	96.2161*** (23.5848)
					F(1,211) = 3.34721 [0.0687]		F(1,211) = 4.1182 [0.0437]	
<b>Bulgaria</b>	0.0936 (0.0666)	0.1092 (0.1289)	21.8505 (17.1414)	21.9582 (15.5027)	0.0519 (0.0693)	0.0328 (0.0815)	54.9971*** (14.2882)	54.7513*** (11.4959)

Source: Author's computations

Note: The parameters with highlighted with bulk are considered the most efficient. With the red font are marked countries were PMC are statistically significant.

Thus, after selecting the most efficient and unbiased specification and which fits the data variations in the best way, we can conclude that in 4 out of 10 emerging and developing countries the monetary policies are influenced by electoral cycles. These are: Moldova, Romania, Russia and Turkey. Additionally, for these countries the test on equality of parameters was strongly rejected.

Our estimations reveal that the behavior of the central bank of Moldova is best described by a non-inertial model with serially correlated error terms (probably due to many exogenous shocks hitting the country). Hence, it becomes less inflation averse in electoral periods. A similar finding holds for Romania, where besides being less

inflation averse before elections, the central bank is less counter-cyclical in comparison with normal times. In Russia the central bank changes its behavior only in response to output gap shocks, being strongly pro-cyclical before elections. Finally, in Turkey, during electoral periods, the monetary policy turns to be pro-inflationary.

### **3.5 Concluding Remarks**

We outline four main hypotheses which will be tested using the methodological framework described in the previous chapter. According to the first one, the incumbent politicians wishing to be reelected tilt the monetary policy to a looser side before elections in order to boost the economic growth and employment. Thus, the central bank's inflation aversion and counter-cyclical behavior is milder during electoral periods in comparison with the normal times. The second hypothesis states that, due to a better institutional framework, the evidence about PMC is less visible or even absent in developed economies in comparison with the developing ones. According to the third hypothesis, the inflation bias is the main outcome of politically sensitive central banks. Thus, the inflation volatility is higher in countries with PMC in comparison with those where the monetary policy did not prove to be election induced. The last hypothesis states that the inflation around elections is higher in comparison with normal times.

The main findings of this chapter are:

- The evidence about PMC is sensitive to model specification, especially in the case of advanced economies. For example, the estimation based on a policy rule with partial adjustment reveals that the monetary policies in these countries proved to be not influenced by the electoral cycles. At the same time, if we estimate a simple non-inertial rule, the PMC prove to be statistically significant for 6 out of 10 advanced countries from our sample.
- Out of all estimation methods, preference was given to the non-inertial reaction function with serially correlated error terms, estimated with 3SLS (GLS), due to its efficiency gains and higher goodness of fit in comparison with the inertial policy rule.
- Following this method, as well as the test on equality of parameters, PMC was not rejected for 2 out of 10 advanced economies from our sample. These are Norway, where the central bank proved to be less inflation averse during

electoral periods, and USA where the FED promotes a pro-cyclical policy before elections and counter-cyclical one in normal times.

- The evidence about PMC is more persistent in developing and emerging economies. Thus, in 4 out of 10 countries from our sample the monetary policies proved to be influenced by electoral cycles. These are: Moldova, Romania, Russia and Turkey. Additionally, for these countries the test on equality of parameters was strongly rejected.

Hence, we can conclude that the 1<sup>st</sup> hypothesis is proved only partially, as not in all countries the central banks are politically sensitive and the monetary policies are manipulated by the incumbent politicians. The 2<sup>nd</sup> hypothesis was entirely proven, since the PMC are much better observed in developing and emerging economies. In the next chapter we will analyze the reason behind this vulnerability of monetary authorities to pressures from political circles.

# Chapter 4: What makes the Central Banks Vulnerable to Political Pressures?

## 4.1 Introductory Remarks

In the previous chapter we have identified several countries where the central banks' behavior are influenced by the electoral cycles: in the proximity of elections the monetary policy, usually, tilts to the easing side in order to stimulate growth and job creation. Two of these countries are from the developed economies group (USA and Norway) and four – from the developing economies group (Moldova, Romania, Russia and Turkey). In this chapter we will try to dig deeper in order to understand the main causes eroding the political independence of these central banks and the transparency of their policy actions.

This analysis will, also, imply a comparison with the central banks' independence index (CBI) elaborated by Cukierman, Webb and Neyapti (1992) and updated by Crowe and Meade (2007). The index is based on 4 main characteristics of the central banks' independence:

1. *Appointments.* The highest degree of independence (1) is received by banks where the governors are appointed by their boards and not by the legislative or executive branch of the government, for more than eight years, cannot be dismissed for any reason and do not hold any other positions in the government.
2. *Policy Formulation.* The highest ranking is given to the central bank formulated its own policy (without the advice or participation of government), had final say in the resolution of a conflict about its legal objectives, and played an active role in the government's budget process.
3. *Policy Objective.* A central bank was judged most independent if its law specified a single objective for price stability. Its score was lower if the law specified multiple, compatible objectives including price stability, and lower still if its multiple objectives were potentially in conflict with price stability. The lowest scores is obtained if the central bank's law stated no policy objectives or if these objectives did not include price stability.

4. *Limits on Central Bank Lending to the Government.* The most independent of central banks would have at most a very limited role in the financing of government deficits.

There are many channels through which votes seeking politicians may influence the central banks' behavior in their own interests: appointing loyal members to the bank's board, participation of Government officials in the decision making process of the central bank, defining the objective in close coordination with the Government, public audit etc. Hence, the degree of independence is directly related to the institutional design and legislative framework.

It is worth to mention that the failure to meet any of these criteria can have negative outcomes for the central banks' activity, the monetary policy efficiency and the overall macroeconomic framework. Thus, when the monetary policy is delegated to a not fully independent central bank, it hampers its accountability and limits the public's control over this institution. Additionally, poor independence coupled with a high margin of discretion makes the central banks vulnerable to the influence of political factors. It creates perverse incentives for politicians to tilt the monetary policy to their own interests with medium and long-run repercussions on the society's interest. Last but not least, poor independence paralleled by unclear accountability significantly hampers the central banks' operational efficiency. Finally, all this negative outcomes are amplified by the lack of transparency of banks' decision making process.

In fact, transparency has an important impact on central bank's independence, as it enhances its accountability and enforced the public's control over its activity, which minimizes the incentives of politicians to influence the monetary policy. Crowe and Meade (2007) provided a comprehensive measurement framework for the central banks' transparency. Thus, they constructed a transparency index which took into account 5 components:

1. *Political Transparency* pertains to the clarity of the central bank's legal mandate;
2. *Economic transparency* refers to the publication of the economic data, models, and forecasts used by the central bank to arrive at its policy decisions;

3. *Procedural transparency* is the communication of the explicit policy strategy as well as information on the decision-making process;
4. *Policy transparency* includes the timely announcement and explanation of policy actions, and some indication of likely future actions;
5. *Operational transparency* is the discussion of economic disturbances and policy errors that are likely to affect the transmission of policy.

All these aspects will be assessed for each of the countries where the political monetary cycles proved to be statistically significant: Norway, USA, Moldova, Romania, Russia and Turkey.

## **4.2 Norges Bank (The Central Bank of Norway)**

The CBI index for the central bank of Norway is much lower in comparison with the average among the same indexes for other countries included in our group of advanced economies (0.32 in comparison with 0.51). Its weakest point is related to the unclear specification of the policy objective. Thus, the bank has several policy objectives which imply price stability, financial stability and added value in investment management. Additionally, the aspects related to policy formulation and limits on lending to government, also, hardly comply with the best practices of the most independent central banks. Both are evaluated with 0.27 points in CBI index.

Other important factors which hamper the independence of the Norges Bank are related to the following facts, which were discussed in more details by Torvik, Vredin and Wilhelmsen (2012):

- All members of its Board are appointed by the government and, also, depend on the government for renewal of their terms. Consequently, it can serve as a channel for political influence before elections, by forcing its Board to vote for easier monetary policy.
- Some members of the Board do not work full time for the central bank and have other jobs outside the bank. It is a quite challenging form of organization and could make the Board biased in its decision making.
- The governors and deputy governors, in many cases, had a background of active politicians, while most of them used to work for the government, before

appointment. Moreover, a governor without work experience in the ministry has not been appointed since the Second World War.

- The Norges Bank Act states that “Before the Bank makes any decision of special importance the matter shall be submitted to the ministry”. It refers to the Ministry of Finance, which confirms the close tie between the central bank and the government. Moreover, the main decision submitted on a regular basis is the decision on the interest rate. Particularly, before each Board meeting, the governor and the deputy governor informs the Ministry of Finance about the interest rate decision which they intend to recommend to the Executive Board. Thus, it is quite safe to assume that in electoral periods, the rent seeking incumbent government has the necessary tools for tilting the central bank’s officials to the side of stimulating the economic growth even above its potential level in order to spur aggregate demand, investments and employment.
- The government has legal rights to modify the decisions made by Norges Bank. It is an additional possibility for political manipulations outlined above and is based on the Norges Bank Act which states that “The King in Council may adopt resolutions regarding the operations of the Bank. Such resolutions may take the form of general rules or instructions in individual cases. The Bank shall be given the opportunity to state its opinion before such resolutions are passed. The Storting shall be notified of resolutions as soon as possible.”

Besides the legal aspects limiting the Norges Bank independence, there are several constraints related to the transparency of its activity. Despite the fact that, according to the central banks’ transparency index, it is ranked almost at the average level of other advanced economies included in our sample (0.7 in comparison with 0.73), it got zero points for policy transparency. Additionally, little information is published from the meetings of the Executive Board. Particularly, the bank does not issue the minutes about the discussed issues and votes of individual members. Consequently, it negatively influences the accountability and limits the incentives for the Board members to increase the quality of the decision making process.

### **4.3 Federal Reserve (Central Bank of USA)**

The CBI index for the Federal Reserve is slightly below the average of other advanced economies from our sample (0.48 in comparison with 0.51). Its main drawback in terms



of best practices of most independent central banks is related to policy formulation. Indeed, there is no clear objective followed by FED, which enjoys a large margin of discretion. Thus, according to the FED Act, the Board of Governors and the Federal Open Market Committee should seek “to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates.” Depending on the overall macroeconomic framework and, as uncovered by our empirical analysis, country’s political situation, the central bank decides to which objective priority should be given.

Besides the unclear stipulation of its goals, they can enter in direct contradiction with each other. For example, in the situation of demand side inflationary pressures, calling for monetary policy tightening, the objective of stable prices contradicts with the one related to maximum employment. At the same time, ensuring maximum employment usually fuels aggregate demand which makes the firm to adjust the prices upwards leading to higher inflationary pressures.

Additionally, the FED monetary policy is hardly insulated from the fiscal one. This deficiency was uncovered during the recent world financial crisis when it committed to holding the interest rates at a very low level by purchasing as much Treasury debt as necessary to maintain the interest rates at their minimum levels.

#### **4.4 The Central Bank of Moldova**

The central bank of Moldova was not included in the independence index of Crowe and Meade (2007). However, the analysis of the legislative framework can reveal several important features which make this central bank quite sensitive to electoral cycles.

- The Law of the National Bank of Moldova obliges it to support the general economic policy of the government, without threatening its main goal: ensuring and maintaining price stability. Although this may seem reasonable, the formulation “(...) *without threatening of its main goal* (...)” may be subject to various interpretations. For example, it may be forced to support the electoral stimulation of employment by easing or at least keeping constant its policy rates, while the resulting inflationary outcomes are motivated by the strong cost-push factors or adjustments to regional prices. As a result, the rhetoric of central bank’s officials is mostly based on the idea that the inflationary pressures are

driven by factors which are out of the monetary policy control (climate conditions, production costs, regional prices). Although this points seem plausible for an open economy which is highly dependent on imports and agriculture, this rhetoric did not change even during periods of 30% y-o-y growth in money supply over 2010.

- Despite the fact that the Law of the Central Bank of Moldova clearly stipulates the interdiction to grant credits or other guarantees to the government, it allows the bank to buy T-bills with maturities of no more than 180 days through open market operations. As a result, given the repercussion of the current Euro zone sovereign debt crisis, the National Bank of Moldova issued an official statement about its commitment to buy T-bills from commercial banks for the next 2 years. The main purpose of this action is to pump liquidity into the banking system and make the monetary policy more predictive and credible. However, it serves as a support for the Government since it fuels the demand for t-bills, driving down the borrowing costs. Hence, this legislative statement creates the possibility to monetize the fiscal deficits under political pressures before elections.
- Despite its recently adopted inflation targeting strategy, the central bank's activity implies many transparency issues. Particularly, the bank's balance sheet is not publicly available. The minutes of the Board meetings are not published as well. There is only a short statement about the monetary policy decision and its motivation, without stating the voting pattern and the debates during the meeting. Additionally, the econometric model used by the bank is not publicly available so that it cannot be replicated, which negatively influences its credibility. Moreover, the bank does not hold consultation meetings with relevant expert and scientific community. All these issues undermine the efficiency of monetary policy decisions and the public accountability of the central bank.
- Finally, most of legislative requirements ensuring the political independence of the central bank were introduced in the mid-2006, under the recommendations of IMF. It means that before that date, the legislation was lacking such basic principles as: a clear specification of the policy objective; direct statement that the Government cannot interfere into the central bank's activity; the monetary authority can neither lend to the Government, nor issue guarantees for it.

## **4.5 The Central Bank of Romania**

The CBI index of the central bank of Romania lies below the average of developing countries included in our sample (0.59 in comparison with 0.74). Its weakest point is related to poor limits on central bank's lending to government, scoring only 0.47 points. Other legal issues were outlined by the ECB Convergence Report (2010) which concluded that the Law of the central bank of Romania does not comply with all the requirements for central bank independence. Particularly, the following issues could be emphasized:

- Article 43 of the Law provides that central bank of Romania must transfer to the State budget an 80% share of the net revenues left after deducting expenses relating to the financial year, including provisions for credit risk, and any losses relating to previous financial years that remain uncovered. This arrangement may in certain circumstances amount to an intra-year credit, which in turn may undermine the financial independence of the central bank (ECB, 2010).
- The same Law states that the auditing of the central bank is made by independent audits selected by the Board based on a legal tender. Nevertheless, the Law concerning the organization and functioning of the Court of Auditors empowers the Court of Auditors to control the management and use of central bank's financial resources and to audit management of the funds of the central bank. As mentions ECB in its Convergence Report (2010), the scope of this audit is not clearly specified by the legislation. Hence, at least theoretically, it opens a door for the Government to exercise certain political pressures on the central bank.

## **4.6 Central Bank of Russia**

There are many factors which restrict the independence of the central bank of Russia. Its CBI index is below the average of the developing economies from our sample (0.62 in comparison with 0.74). Its main drawback, as revealed by Crowe and Meade (2007) is related to policy formulation. Indeed, the legislation does not stipulate a clearly a single monetary policy objective. Instead, it states that the central bank of Russia should ensure the stability of the national currency, strengthen and develop the banking sector

and maintain an efficient payments system. Besides this, many other issues related to the independence of this central bank stem from the deficiencies of the democratic system as a whole characterized by high centralization of political and executive power, strong state influence of economic activity and, respectively, political interference into the monetary policy (Johnson, 2004). The main factors hampering the independence of the central bank of Russia are:

- The composition of the National Banking Council of the central bank reveals a strong appointment channel for political pressures: the 12 members include 3 representatives from the government, 3 from the presidential administration, 5 from the legislature and only 1 from the central bank of Russia. Hence, it limits the bank's autonomy and provides the incumbent politicians the necessary tools for exercising political pressures.
- Most of the governors and vice-governors had active political background and/or used to be employed by the government. For example, the current governor appointed in 2002 used to be First Deputy Finance Minister and presidential aide. As a result, the insulation of the monetary policy from the fiscal one is quite blurred, the central bank being highly influenced by the executive branch of the power.
- The central bank is one of the least transparent in comparison with the analyzed countries with a transparency index of only 0.2 points. Thus, the bank earned zero points for economic, procedural, policy and operational transparency.

#### **4.7 The Central Bank of Turkey**

Despite a relatively high CBI index (0.85) in comparison with the average among the sample countries (0.74), there are several issues which made the central bank of Turkey exposed to political pressures and electoral cycles. The most important of them are:

- According to the Law of the Central Bank, the Board members are elected only for 3 years, which comes in contradiction with the best practices of independent central banks, which state that the governor and the Board have to be elected for a period longer than the electoral cycle.

- The Governor is appointed by the Council of Ministers, which is the executive branch of the government. It also does not comply with the main principles of central bank's independence according to which the governors are appointed by the legislative power of the president.
- The Law on the Central Bank states that "The Prime Minister may have the operations and accounts of the Bank audited", which could be a measure of political influence on the bank. Normally, the central bank hires an external auditing firm, based on a tender, while the government shouldn't have such prerogatives.
- Generally, the same Law lacks any direct specification that the Central Bank of Turkey is independent and the monetary policy is insulated from the fiscal one. Moreover, there are no clear stipulations prohibiting the practices of lending to the Government.

#### **4.8 Concluding Remarks**

For each country where the monetary policies proved to be politically sensitive there were depicted the main factors affecting the central banks' independence. Additionally, transparency issues were, also, considered as important buffers against the political pressures from the incumbent government. In most cases, the major deficiencies lay in the institutional design and legislative framework which leave some rooms for political manipulations of the central banks. Particularly:

- The Board of the central bank of Norway is appointed by the government and can be easily dismissed. Additionally, the bank has close ties with the executive power both unofficially (e.g. some governors and deputy governors used to work for some ministries) and officially (e.g. the governor and deputy governors must consult with the Ministry of Finance about their policy decisions). Moreover, the government has legal rights to modify the decisions made by the Norges Bank. Besides these, there are many transparency issues (e.g. little information is published from the meetings of the Executive Board).
- The main peculiarity which creates the possibilities for political manipulations of FED is related to its large margin of discretion. Thus, it has multiple objectives and the central bank decides to which of them priority should be

given. Additionally, these objectives often can enter in contradiction with each other (e.g. stable prices and high employment).

- Most of legislative requirements ensuring the political independence of the central bank of Moldova were introduced in the mid-2006. It means that before that date, the legislation was lacking basic principles of central bank's independence and insulation of monetary policy from the fiscal one. Additionally, the bank doesn't publish the minutes of Board meetings, the econometric model used for their forecasts or even the bank's balance sheet.
- According to the ECB Convergence Report (2010), the Law of the central bank of Romania does not comply with all the requirements for central bank independence. Particularly, it relates to its financial independence and the unclear aspects of auditing of its activity.
- The low independence of the central bank of Russia derives from the high centralization of executive and legislative powers. Thus, the main issues are related to the unclear specification of policy objectives, close ties with the government and poor transparency.
- In Turkey, the main tools which can be used by the government to influence the monetary policy decisions are: (i) the Board is appointed only for 3 years; (ii) the Governors is appointed by the government; (iii) government may conduct the audit of the central banks, and (iv) no clear specifications about insulation of the monetary policy from the fiscal one.

# **Chapter 5: The Outcomes of Political Monetary Cycles**

## **5.1 Introductory Remarks**

While the previous chapter outlined the main factors explaining the election induced monetary policy, this chapter discusses the main outcomes for the economy with a politically sensitive central bank. Thus, it provides a theoretical framework for describing the dynamic inconsistency problem and its resulting inflation bias. These hypotheses are empirically tested on our samples of advanced and developing economies. Particularly, we analyze the differences in the inflation level in electoral and non-electoral periods. Additionally, we compare the inflation volatility between countries with and without political monetary cycles, according to the findings from chapter 3.

## **5.2 The Dynamic Inconsistency Problem and Inflationary Bias**

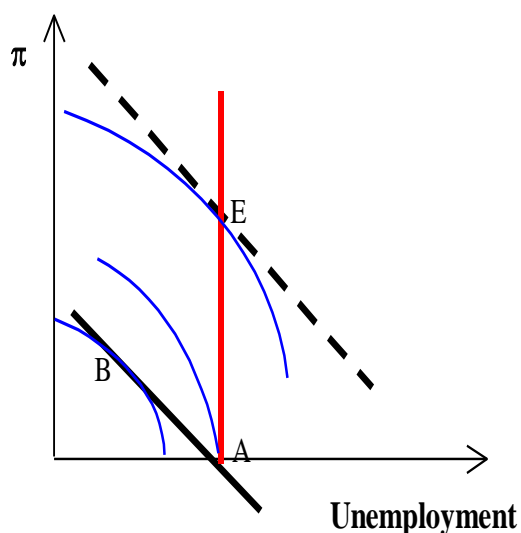
In order to better understand the outcomes of politically sensitive central banks, which are directly linked to their independence, it is necessary to elaborate on the dynamic inconsistency problem and its inflationary bias effect, following the seminal paper of Kydland and Prescott (1977) and the lecture notes of Mr. T. Hollub (2011).

First of all, we will discuss the impact of central bank's deviation from its policy rule under the assumption of rational expectations.

Point A from the figure 1 marks the initial state of the economy where the inflation ( $\pi$ ) is at its lowest level (due to central bank's inflation aversion), while the unemployment is at its structural level. Once the central bank, under political pressures, deviates from its rule and promotes a looser monetary policy, the economy moves to point B. Now, while the inflation level does not exceed the society's indifference curve, the unemployment is driven below its structural level. Obviously, it helps the incumbent politicians to buy more electorate, as voters enjoy more incomes in nominal terms and the economy is boosted above its potential level. However, under a rationality assumption this may not remain a long-term equilibrium because the population incorporates any inflation surprises into their expectations. Hence, in the long-run, the central bank is penalized

for its discretionary policy and political sensitivity which makes it harder to anchor the inflationary expectations. As a result, given the distortionary effects of inflation, the economy shifts to the point E, as the unemployment reverts to its structural level and the inflation is boosted well above the initial level.

**Figure 1: Philips Curve and inflation bias**



Thus, the temptation of the central bank to deviate from its commitment to ensure price stability and boost employment by engineering extra inflation leads, finally, to a strong inflation bias with negative effects on the entire economy. It is worth mentioning that if people would be rational in the short-run, not just in the long run as it was the case in our example, the economy would switch directly to point E, without any short-term benefits earned in point B. Hence, we can conclude that the politicians are exploring the short-term irrationality of their voters by engineering inflation in order to immediately boost the economy, while its consequences are felt with a certain time lag.

This pattern of monetary policy which periodically generates inflation surprises creates a dynamic inconsistency problem. To describe this issue, let's assume an economy where the output ( $y_t$ ) is determined by its potential level ( $y_t^*$ ), inflation surprise (deviation of current inflation from its expected level:  $(\pi_t - \pi_t^e)$ ) and a supply side shock ( $z_t$ ):

$$\text{Phillips Curve: } y_t = y_t^* + (\pi_t - \pi_t^e) - z_t$$



Respectively, the central bank follows a social loss minimization function: its policy rate ( $\Lambda_t$ ) is positively correlated with the inflationary pressures multiplied by an inflation aversion parameter ( $\chi\pi_t$ ) and deviation of the current output from the desired one ( $y_t - y_t^{**}$ ).

$$\text{Social loss function: } \Lambda_t = \chi\pi_t^2 + [y_t - y_t^{**}]^2$$

Additionally, the desired level of output is assumed to be higher than its potential level, revealing the policy makers' tendency to boost the economic above its potential:

$$\text{Output target: } k = y_t^{**} - y_t^* > 0$$

In order to determine the optimal level of inflation, given this setting, we plug in the Phillips Curve into the social loss function:

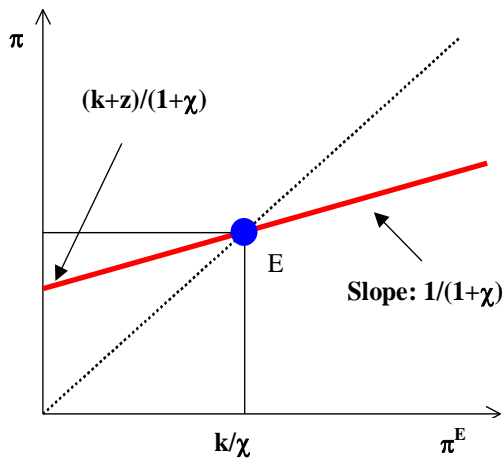
$$\Lambda_t = \chi\pi_t^2 + [y_t^* + (\pi_t - \pi_t^e) - z_t - y_t^{**}]^2$$

$$\Lambda_t = \chi\pi_t^2 + [\pi_t - \pi_t^e - z_t - k]^2$$

Finally, in order to derive the central bank's reaction function, we minimize  $\Lambda_t$  with respect to  $\pi_t$ .

$$\text{Reaction function: } \pi_t = \frac{\pi_t^e + z_t + k}{1 + \chi}$$

**Figure 2: Dynamic Inconsistency Problem**



Hence, in this simple economic setting, each inflation surprise is incorporated in inflationary expectations till the economy reached the equilibrium point E. At that stage, the central bank does not have any additional incentive to introduce new inflationary surprises because of hyperinflation risks.

Thus, we can notice that the new equilibrium is characterized by an inflationary bias. Importantly, this is a direct outcome of policy makers' desire to boost the economy above its potential level  $k = y_t^{**} - y_t^* > 0$ , which can be the case of a politically

manipulated central bank. At the same time, this inflation bias disappears if the desired output is equal with its potential level ( $y_t^{**} = y_t^*$ ) so that the central bank is not so assertive about the economic growth. Additionally, higher is the inflation aversion of the central bank ( $\chi$ ), lower is the inflation bias, due to a tighter and more counter-cyclical monetary policy. Obviously, such a policy stance could hardly be agreed by politicians and their electorate who are assumed to heavily discount the future by putting more emphasis on short-term benefits of economic growth and disregarding its long-run inflationary effects. Hence, the central bank's political independence is one of the main building blocks of an economy with no inflation bias, where the monetary policy is guided by a clearly specified policy rule with a limited margin of discretion. Rogoff (1985) confirmed the importance of inflation aversion of the central bank, arguing that an efficient measure for achieving a low and stable inflation is to appoint a central banker whose inflation aversion is even stronger than that of the society.

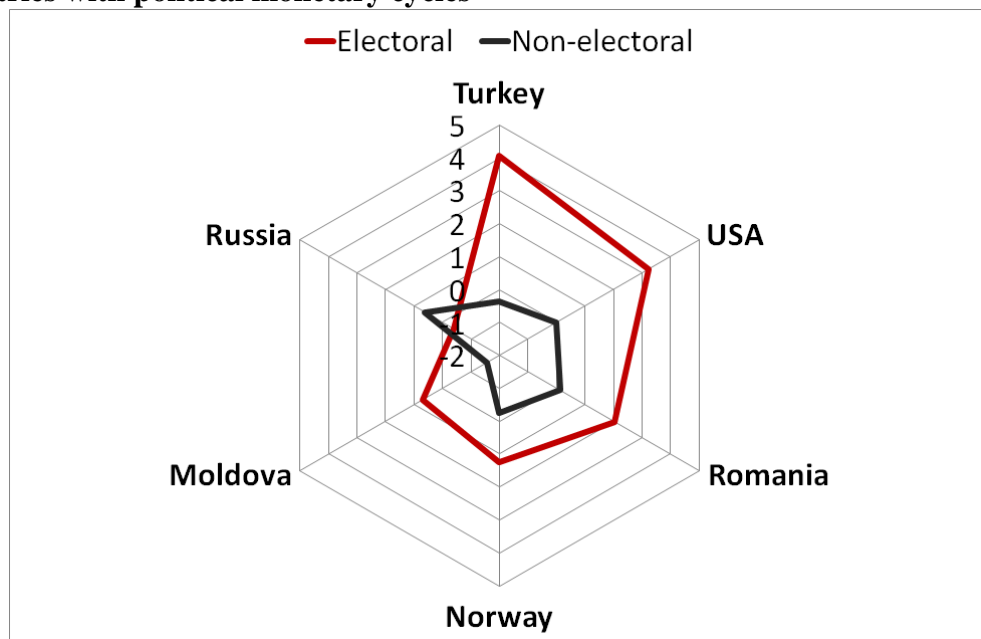
These theoretical assumptions will be empirically tested in the next sub-chapters which will reveal the outcomes of politically motivated monetary policies.

### **5.3 Switching the Electoral Cycles to Electoral Inflation**

Usually, a lower inflation aversion and milder counter-cyclical (or even pro-cyclical) behavior of some central banks in the proximity of elections, as estimated in the previous sub-chapters, can create strong inflationary biases. The main source of this increase in inflation around elections comes from pressures exerted by incumbent politicians on some central bank officials to engineer more economic growth and, in this way, create more jobs and buy votes. As a direct outcome, inflation is, usually, higher in the proximity of elections in the countries where the PMC proved to be significant (Grier (1989), Klein (1996), Alesina and Rosenthal (1995), Drazen (2001) and others).

The hypothesis of higher inflation around elections is confirmed in our sample. Thus, we find that in all countries (except Russia) where the political cycles do influence the monetary policies, inflation tends to be higher in the proximity of elections and is lower in normal times. This statement is revealed by the chart 1, which illustrates that CPI has a bigger skew in electoral periods in comparison with non-electoral ones for countries where PMC are found to be statistically significant.

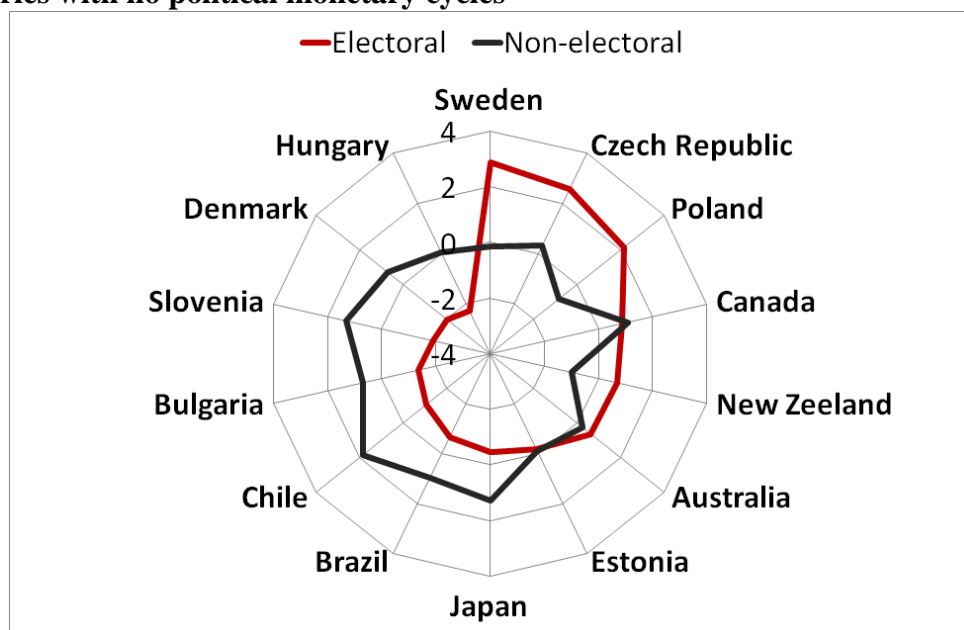
**Chart 1: Skewness (3<sup>rd</sup> moment) of CPI in Electoral and Non-electoral periods, countries with political monetary cycles**



*Source: Author's calculations based on OECD data*

Thus, we can notice that only in Russia the electoral inflation has a lower skew in comparison with the non-electoral one. At the same time, in countries where PMC hypothesis has been rejected, the discrepancy between electoral and non-electoral inflation skewness is lower. At the same time, there is no clear pattern on the fact that inflation tends to be higher in the proximity of elections (chart 2).

**Chart 2: Skewness (3<sup>rd</sup> moment) of CPI in Electoral and Non-electoral periods, countries with no political monetary cycles**



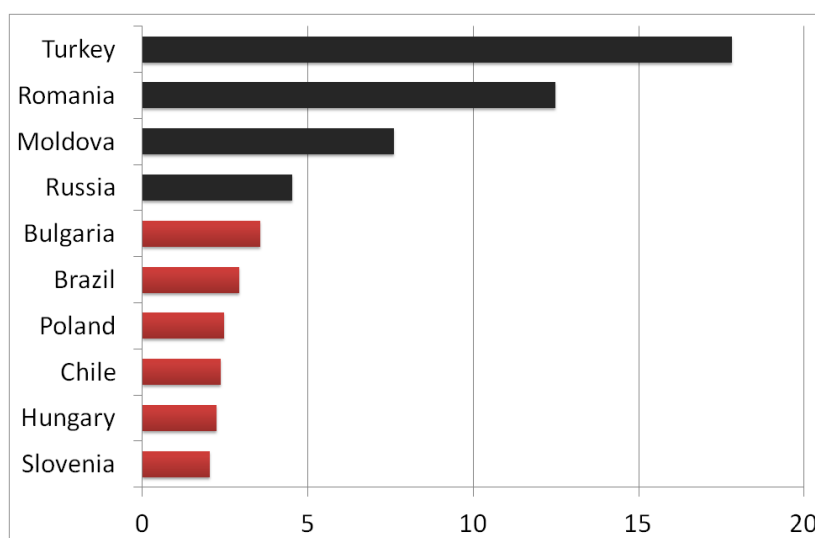
*Source: Author's calculations based on OECD data*

## 5.4 Impact on Central Bank's Reputation

The electoral inflation is not the single outcome of politically sensitive monetary policies. According to most reputational models, the central bank's temptation to cheat by delivering periodically (in our case this might be around elections) unexpected inflation serves as the main source for "inflation bias" emphasized by Kydland and Prescott (1977) and Robert J. Barro and Davis Gordon (1983). Hence, the economic agents understand the central bank's regime switching behavior and its vulnerability to political pressures, which translates into a dramatic loss of monetary policy credibility. Given the fact that a successful anti-inflationary policy directly depends on central bank's ability to anchor inflationary expectations, its poor reputation translates into a strong inflationary bias and central bank's failure to keep the price level stable. This idea corroborates with the findings of Bade and Parkin (1982), Alesina (1988, 1989) and Grilli, Maciandaro and Tabellini (1991), that more independent central banks are associated with lower levels of inflation.

The above outlined hypothesis is proven empirically in our sample. The positive relation between the degree of political biases in the monetary policy and inflation volatility is mostly visible in developing economies. Thus, the chart 3 reveals that Turkey, Romania, Moldova and Russia – the countries where the central banks are influenced by the electoral cycles – registered the highest standard deviation of consumer price index (used as a proxy for inflation volatility).

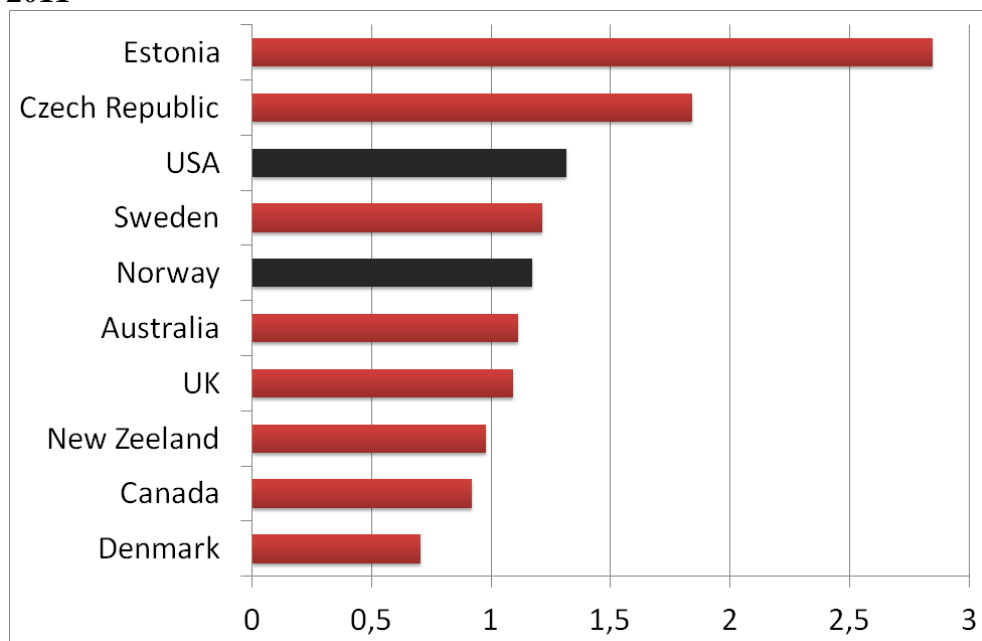
**Chart 3: Standard deviation of quarterly CPI, in developing economies, period 2000-2011**



*Source: Author's calculations based on OECD data*

In the case of advanced economies, the USA and Norway – the countries with political monetary cycles – also register relatively high inflation volatility, though are not placed in the top. Still, if we eliminate Estonia and Czech Republic, which have quite low GDP/capita in comparison with the rest of advanced economic included in the sample, USA would be the 1<sup>st</sup> and Norway the 3<sup>rd</sup> according to inflation volatility (chart 4).

**Chart 4: Standard deviation of quarterly CPI, in advanced economies, period 2000-2011**



*Source: Author's calculations based on OECD data*

## 5.5 Concluding Remarks

Inflation bias is the main outcome of politically sensitive monetary policies. Thus, countries with PMC register much higher inflation volatility in comparison with the rest of the sample. Moreover, in these countries, except Russia, the inflation around inflation tends to be higher than in normal times. This is a direct result of the incumbent politicians' pressures on the monetary authorities to boost employment and aggregate demand which is done by engineering some extra-inflation. In conclusion, the central banks' political independence do matter, as it minimizes the inflation bias and, thus, ensures a more favorable and predictable macroeconomic framework.

## Chapter 6: Final Conclusions

Despite the broad institutional and legislative reformatting of the central banks' activity all over the world aimed at granting the monetary authorities with more independence, the issue of political monetary cycles is still a problem for number countries. According to our empirical results, the election induced monetary policies are more persistent in developing countries, where 4 out of 10 countries from our sample are found to have regime switching behavior consistent with the election cycle. These countries are Moldova, Romania, Russia and Turkey. At the same time, in 2 out of 10 advanced economies, the central banks proved to be politically sensitive: Norway and USA. In all these countries, the monetary policy is tilting to the easing side in the proximity of elections, which is, most probably, the result of political pressures of incumbent government, aimed at boosting the employment in order to gain more votes.

The main explanatory factors of these electoral monetary policies resume to their poor insulation from the fiscal policies, as well as the appointment of the governor or board members by the government, active political background of the governor or board members, the possibility for the government to conduct the audit of the central bank, poorly specified monetary policy objectives and many other factors limiting the central banks' independence. Transparency level, also, plays a crucial role as it improves the accountability of central banks and limits the perverse incentives of politicians to tilt the monetary policy to their electoral interests.

Obviously, the electoral induced monetary policies have a series of impacts on the economy and society. Thus, in most of countries where the political monetary cycles proved to be significant the inflation tends to increase around elections. This is the result of incumbent politicians' pressures on the central banks to promote easier monetary policies before elections. In this way, by engineering inflation, which is not immediately perceived by voters, the central banks spur the employment and stimulate the aggregate demand, creating more favorable macroeconomic conditions for the government wishing to get reelected.

Another well-known outcome of such manipulations with the monetary policies is the inflation bias, as revealed by the dynamic inconsistency problem. Thus, in all countries where the central banks appear to be influenced by electoral cycles, the inflation

volatility is higher in comparison with the other countries from our sample. Given the fact that inflation is perceived as an invisible tax and erodes the purchasing power of the population, the political monetary cycles imply substantial welfare losses. Additionally, more volatile macroeconomic situation fuels the uncertainty along with risk premiums, with direct repercussions on investment activity, job creation and overall economic development.

These findings have important implications both for policy and research communities. Following the dynamic inconsistency problem we can conclude that the political monetary cycles represent a direct outcome of short-run irrationalities of voters who heavily discount the future and value the most the immediate benefits obtained from higher employment. Consequently, the incumbent politicians explore this short-time irrationality of their electorate for immediate gains, while the countercyclical policies are left for the post-electoral periods.

Thus, the importance of designing an adequate legislative framework for minimization of these perverse incentives of politicians is imperative. It calls for broad legislative and institutional reformation which would ensure the full independence of the central banks, especially for countries where political monetary cycles proved to be significant. These actions should, at least, lead to a clear stipulation of policy objective, insulation of the monetary policy from the fiscal one, elimination of government interventions in the monetary policy decisions and increasing the transparency of the central banks' activity. Additionally, the statistical significance of electoral regime switching behavior of some central banks, as found by a broad amount of empirical research, including this master thesis, should motivate the researchers to enrich the models used for analyzing the monetary policies with additional variables controlling for electoral cycles.

In conclusion, political monetary cycles do exist and they do matter...

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## Annex A: Gretl Script

```
#Specify electoral and non-electoral variables
CPI_E = CPI*E
CPI_nE = CPI*(1-E)
CPI_1_E = CPI(-1)*E
CPI_1_nE = CPI(-1)*(1-E)
STI_1_E = STI(-1)*E
STI_1_nE = STI(-1)*(1-E)
hp_GDP_E = hp_1_GDP*E
hp_GDP_nE = hp_1_GDP*(1-E)
hp_GDP_1_E = hp_1_GDP(-1)*E
hp_GDP_1_nE = hp_1_GDP(-1)*(1-E)
hp_IPI_E = hp_IPI*E
hp_IPI_nE = hp_IPI*(1-E)

# OLS
ols STI const STI_1_E STI_1_nE CPI_E CPI_nE hp_GDP_E hp_GDP_nE
VCOV_OLS = $vcv
COEF_OLS = $coeff

#2SLS
tsls STI const STI_1_E STI_1_nE CPI_E CPI_nE hp_GDP_E hp_GDP_nE; const
CPI_1_E STI_1_E hp_GDP_1_E hp_IPI_E CPI_1_nE STI_1_nE hp_GDP_1_nE
hp_IPI_nE
VCOV_2SLS = $vcv
COEF_2SLS = $coeff

# Hausman's statistics for OLS vs. 2SLS
H1=(COEF_2SLS-COEF_OLS)*inv(VCOV_2SLS-VCOV_OLS)*(COEF_2SLS-
COEF_OLS)
p1=pvalue(X,5,H1)

# 3SLS
system name = country_name
equation STI const STI_1_E STI_1_nE CPI_E CPI_nE hp_GDP_E hp_GDP_nE
equation CPI_E const CPI_1_E STI_1_E
equation CPI_nE const CPI_1_nE STI_1_nE
equation hp_GDP_E const hp_GDP_1_E hp_IPI_E
equation hp_GDP_nE const hp_GDP_1_nE hp_IPI_nE
endog STI CPI_E hp_GDP_E CPI_nE hp_GDP_nE
end system

estimate country_name method=3sls

# Divide coefficient and Vcov matrices for both equations
VCOV_3SLS = $vcv[1:5,1:5]
COEF_3SLS = $coeff[1:5]
```

```

# Hausman's statistics for 2SLS vs. 3SLS
H3=(COEF_2SLS-COEF_3SLS)'*inv(VCOV_2SLS-VCOV_3SLS)*(COEF_2SLS-
COEF_3SLS)
p3=pvalue(X,5,H3)

# Testing the equality of regression parameters by imposing restrictions
restrict
    b[1,2]-b[1,3]=0
    b[1,4]-b[1,5]=0

end restrict

# Estimate the model again in order to test whether the restrictions are true
estimate country_name method=3sls

#Obtain the error terms
u_E_1 = uhat_s01(-1)*E
u_nE_1 = uhat_s01(-1)*(1-E)

#Run the 3SLS model with serially correlated error terms
system name = country_name
    equation STI const CPI_E CPI_nE hp_GDP_E hp_GDP_nE u_E_1 u_nE_1
    equation CPI_E const CPI_1_E STI_1_E
    equation CPI_nE const CPI_1_nE STI_1_nE
    equation hp_GDP_E const hp_GDP_1_E hp_IPI_E
    equation hp_GDP_nE const hp_GDP_1_nE hp_IPI_nE
    endog STI CPI_E hp_GDP_E CPI_nE hp_GDP_nE
end system

estimate country_name method=3sls

# Testing the equality of regression parameters by imposing restrictions
restrict
    b[1,2]-b[1,3]=0
    b[1,4]-b[1,5]=0

end restrict

# Estimate the model again in order to test whether the restrictions are true
estimate country_name method=3sls

```

# Annex B: Gretl Output

## Australia

Model 1: OLS, using observations 1980:2-2010:4 (T = 123)

Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	1.54388	0.743973	2.075	0.0402	**
STI_1_E	0.922504	0.0360234	25.61	1.47e-049	***
STI_1_nE	0.939618	0.0355589	26.42	6.55e-051	***
CPI_E	-0.0128067	0.00665704	-1.924	0.0568	*
CPI_nE	-0.0131423	0.00658400	-1.996	0.0483	**
hp_GDP_E	0.216565	0.0804425	2.692	0.0081	***
hp_GDP_nE	0.196475	0.0763621	2.573	0.0113	**

Mean dependent var	8.913209	S.D. dependent var	4.552406
Sum squared resid	117.9702	S.E. of regression	1.008457
R-squared	0.953342	Adjusted R-squared	0.950928
F(6, 116)	395.0251	P-value(F)	1.01e-74
Log-likelihood	-171.9617	Akaike criterion	357.9234
Schwarz criterion	377.6087	Hannan-Quinn	365.9195
rho	0.189206	Durbin-watson	1.565592

Model 2: TSLS, using observations 1980:2-2010:4 (T = 123)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	1.43540	0.771934	1.859	0.0630	*
STI_1_E	0.921316	0.0374539	24.60	1.31e-133	***
STI_1_nE	0.942837	0.0366013	25.76	2.51e-146	***
CPI_E	-0.0108459	0.00688155	-1.576	0.1150	
CPI_nE	-0.0117982	0.00686679	-1.718	0.0858	*
hp_GDP_E	0.104655	0.104272	1.004	0.3155	
hp_GDP_nE	0.315890	0.104320	3.028	0.0025	***

Mean dependent var	8.913209	S.D. dependent var	4.552406
Sum squared resid	122.5074	S.E. of regression	1.027666
R-squared	0.951551	Adjusted R-squared	0.949045
F(6, 116)	379.9410	P-value(F)	8.66e-74
rho	0.170308	Durbin-watson	1.597686

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 15.1446

with p-value = 0.00441045

Equation 1: 3SLS, using observations 1980:3-2010:4 (T = 122)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE

hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	21.4088	0.768824	27.85	1.20e-170	***
CPI_E	-0.161288	0.0105116	-15.34	3.90e-053	***
CPI_nE	-0.165666	0.00989905	-16.74	7.22e-063	***
hp_GDP_E	-0.258662	0.235939	-1.096	0.2729	
hp_GDP_nE	-0.245104	0.234388	-1.046	0.2957	
u_E_1	1.14980	0.299886	3.834	0.0001	***
u_nE_1	1.14689	0.319465	3.590	0.0003	***

Mean dependent var	8.874410	S.D. dependent var	4.550713
Sum squared resid	752.2189	S.E. of regression	2.483089
R-squared	0.700489	Adjusted R-squared	0.684863



## Bulgaria

Model 2: OLS, using observations 2000:2-2011:4 (T = 47)

Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	1.20860	0.400104	3.021	0.0044	***
STI_1_E	0.346434	0.148460	2.334	0.0247	**
STI_1_nE	0.586371	0.115641	5.071	9.45e-06	***
CPI_E	0.0743577	0.0587589	1.265	0.2130	
CPI_nE	-0.0294321	0.0587584	-0.5009	0.6192	
hp_GDP_E	31.0766	12.8896	2.411	0.0206	**
hp_GDP_nE	32.7240	9.55724	3.424	0.0014	***

Mean dependent var	2.450426	S.D. dependent var	1.540038
Sum squared resid	23.78279	S.E. of regression	0.771083
R-squared	0.782007	Adjusted R-squared	0.749308
F(6, 40)	23.91539	P-value(F)	8.52e-12
Log-likelihood	-50.68225	Akaike criterion	115.3645
Schwarz criterion	128.3155	Hannan-Quinn	120.2381
rho	-0.143369	Durbin-Watson	2.213336

Excluding the constant, p-value was highest for variable 9 (CPI\_nE)

Model 3: TSLS, using observations 2000:2-2011:4 (T = 47)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	0.0281007	0.867482	0.03239	0.9742	
STI_1_E	0.612104	0.229963	2.662	0.0078	***
STI_1_nE	0.502085	0.147744	3.398	0.0007	***
CPI_E	0.124697	0.0842600	1.480	0.1389	
CPI_nE	0.199168	0.153590	1.297	0.1947	
hp_GDP_E	12.2850	21.6528	0.5674	0.5705	
hp_GDP_nE	6.94411	19.5451	0.3553	0.7224	

Mean dependent var	2.450426	S.D. dependent var	1.540038
Sum squared resid	33.08315	S.E. of regression	0.909439
R-squared	0.701126	Adjusted R-squared	0.656295
F(6, 40)	16.88555	P-value(F)	1.34e-09
rho	-0.034217	Durbin-Watson	2.065912

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 8.64839

with p-value = 0.0146639

Equation 1: 3SLS, using observations 2000:3-2011:4 (T = 46)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	2.23987	0.479313	4.673	2.97e-06	***
CPI_E	0.0519852	0.0693757	0.7493	0.4537	
CPI_nE	0.0328564	0.0815663	0.4028	0.6871	
hp_GDP_E	54.9971	14.2882	3.849	0.0001	***
hp_GDP_nE	54.7513	11.4959	4.763	1.91e-06	***
u_E_1	-0.357929	0.575134	-0.6223	0.5337	
u_nE_1	0.471521	0.164922	2.859	0.0042	***

Mean dependent var	2.429130	S.D. dependent var	1.550043
Sum squared resid	33.69371	S.E. of regression	0.855846
R-squared	0.690438	Adjusted R-squared	0.642813

## Brazil

Model 1: OLS, using observations 1996:2-2010:4 (T = 59)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	13.9513	5.19351	2.686	0.0097	***
STI_1_E	0.711882	0.112850	6.308	6.26e-08	***
STI_1_nE	0.530648	0.137891	3.848	0.0003	***
CPI_E	-0.0868342	0.0404867	-2.145	0.0367	**
CPI_nE	-0.0674679	0.0428069	-1.576	0.1211	
hp_GDP_E	109.025	64.4615	1.691	0.0968	*
hp_GDP_nE	-27.5002	67.2874	-0.4087	0.6844	
Mean dependent var	19.23458	S.D. dependent var	8.694109		
Sum squared resid	1115.451	S.E. of regression	4.631521		
R-squared	0.745568	Adjusted R-squared	0.716210		
F(6, 52)	25.39607	P-value(F)	7.56e-14		
Log-likelihood	-170.4319	Akaike criterion	354.8639		
Schwarz criterion	369.4067	Hannan-Quinn	360.5408		
rho	-0.175677	Durbin-Watson	2.350512		

Excluding the constant, p-value was highest for variable 17 (hp\_GDP\_nE)

Model 2: TSLS, using observations 1996:2-2010:4 (T = 59)  
Dependent variable: STI

Instruments: STI\_1\_E STI\_1\_nE CPI\_E CPI\_nE hp\_IPI\_E hp\_IPI\_nE  
Instruments: const CPI\_1\_E hp\_IPI\_1\_E hp\_GDP\_E CPI\_1\_nE hp\_IPI\_1\_nE  
hp\_GDP\_nE

	coefficient	std. error	z	p-value	
const	160.210	1636.28	0.09791	0.9220	
STI_1_E	-3.20429	43.7059	-0.07331	0.9416	
STI_1_nE	-2.17113	31.0632	-0.06989	0.9443	
CPI_E	-0.903998	9.15956	-0.09869	0.9214	
CPI_nE	-1.12510	11.6478	-0.09659	0.9230	
hp_IPI_E	-0.580002	12.9812	-0.04468	0.9644	
hp_IPI_nE	-1.37959	15.6362	-0.08823	0.9297	
Mean dependent var	19.23458	S.D. dependent var	8.694109		
Sum squared resid	26465.71	S.E. of regression	22.56005		
R-squared	0.018183	Adjusted R-squared	-0.095104		
F(6, 52)	0.791153	P-value(F)	0.580998		
Log-likelihood	-1140.348	Akaike criterion	2294.695		
Schwarz criterion	2309.238	Hannan-Quinn	2300.372		
rho	0.741775	Durbin-Watson	0.498084		

Hausman test -

Null hypothesis: OLS estimates are consistent  
Asymptotic test statistic: Chi-square(6) = 34.2459  
with p-value = 6.03045e-006

Equation 1: 3SLS, using observations 1996:2-2010:4 (T = 59)  
Dependent variable: STI

Instruments: const STI\_1\_E STI\_1\_nE CPI\_1\_E CPI\_1\_nE hp\_GDP\_1\_E  
hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	11.7488	4.56264	2.575	0.0100	**
STI_1_E	0.755528	0.0978954	7.718	1.18e-014	***
STI_1_nE	0.582117	0.125841	4.626	3.73e-06	***
CPI_E	-0.0722985	0.0359194	-2.013	0.0441	**
CPI_nE	-0.0546844	0.0376827	-1.451	0.1467	
hp_GDP_E	27.8597	70.2939	0.3963	0.6919	
hp_GDP_nE	-8.66844	66.8306	-0.1297	0.8968	
Mean dependent var	19.23458	S.D. dependent var	8.694109		
Sum squared resid	1166.778	S.E. of regression	4.447009		
R-squared	0.734100	Adjusted R-squared	0.703419		

## Canada

Model 1: OLS, using observations 1980:2-2010:4 (T = 123)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	1.96269	1.11085	1.767	0.0799	*
STI_1_E	0.893354	0.0638884	13.98	1.21e-026	***
STI_1_nE	0.911482	0.0418919	21.76	9.33e-043	***
CPI_E	-0.0189460	0.00987523	-1.919	0.0575	*
CPI_nE	-0.0171911	0.0105215	-1.634	0.1050	
hp_GDP_E	0.265904	0.117662	2.260	0.0257	**
hp_GDP_nE	0.230904	0.0500986	4.609	1.05e-05	***
Mean dependent var	6.841012	S.D. dependent var	4.285863		
Sum squared resid	98.38539	S.E. of regression	0.920951		
R-squared	0.956097	Adjusted R-squared	0.953826		
F(6, 116)	421.0313	P-value(F)	2.98e-76		
Log-likelihood	-160.7970	Akaike criterion	335.5940		
Schwarz criterion	355.2792	Hannan-Quinn	343.5901		
rho	0.034730	Durbin-Watson	1.928299		

Excluding the constant, p-value was highest for variable 9 (CPI\_nE)

Model 2: TSLS, using observations 1980:2-2010:4 (T = 123)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	1.83750	1.12248	1.637	0.1016	
STI_1_E	0.895004	0.0647865	13.81	2.08e-043	***
STI_1_nE	0.919034	0.0424069	21.67	3.79e-104	***
CPI_E	-0.0178954	0.00997451	-1.794	0.0728	*
CPI_nE	-0.0160825	0.0106300	-1.513	0.1303	
hp_GDP_E	0.303296	0.138313	2.193	0.0283	**
hp_GDP_nE	0.284579	0.0568950	5.002	5.68e-07	***

Mean dependent var	6.841012	S.D. dependent var	4.285863
Sum squared resid	99.44493	S.E. of regression	0.925896
R-squared	0.955632	Adjusted R-squared	0.953337
F(6, 116)	417.3279	P-value(F)	4.86e-76
rho	0.021399	Durbin-Watson	1.954870

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 9.67323

with p-value = 0.0463069

Equation 1: 3SLS, using observations 1980:3-2010:4 (T = 122)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	22.6111	0.694334	32.57	1.28e-232	***
CPI_E	-0.200897	0.00812798	-24.72	7.07e-135	***
CPI_nE	-0.195049	0.00850026	-22.95	1.61e-116	***
hp_GDP_E	0.235159	0.234982	1.001	0.3169	
hp_GDP_nE	0.0272348	0.101579	0.2681	0.7886	
u_E_1	0.746341	0.400545	1.863	0.0624	*
u_nE_1	1.18714	0.174669	6.797	1.07e-011	***

Mean dependent var	6.785768	S.D. dependent var	4.259335
Sum squared resid	407.7975	S.E. of regression	1.828279
R-squared	0.814270	Adjusted R-squared	0.804580

## Czech Republic

Model 1: OLS, using observations 1997:2-2011:2 (T = 57)  
Dependent variable: REPO

	coefficient	std. error	t-ratio	p-value	
const	0.516982	0.234734	2.202	0.0323	**
REPO_1_E	0.503909	0.0822724	6.125	1.40e-07	***
REPO_1_nE	0.632408	0.0270447	23.38	1.40e-028	***
CPI_E	0.468154	0.142803	3.278	0.0019	***
CPI_nE	0.173113	0.0889099	1.947	0.0572	*
hp_GDP_E	31.5072	19.1650	1.644	0.1065	
hp_GDP_nE	1.87797	8.27081	0.2271	0.8213	
Mean dependent var	4.560526	S.D. dependent var	4.822934		
Sum squared resid	36.09467	S.E. of regression	0.849643		
R-squared	0.972290	Adjusted R-squared	0.968965		
F(6, 50)	292.4033	P-value(F)	3.87e-37		
Log-likelihood	-67.85767	Akaike criterion	149.7153		
Schwarz criterion	164.0167	Hannan-Quinn	155.2733		
rho	0.304835	Durbin-Watson	1.300215		

Excluding the constant, p-value was highest for variable 18 (hp\_GDP\_nE)

Model 2: TSLS, using observations 1997:2-2011:2 (T = 57)  
Dependent variable: REPO  
Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE  
Instruments: const CPI\_1\_E REPO\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
REPO\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	0.156858	0.304412	0.5153	0.6064	
REPO_1_E	0.360489	0.101391	3.555	0.0004	***
REPO_1_nE	0.613960	0.0323762	18.96	3.43e-080	***
CPI_E	0.750713	0.183674	4.087	4.37e-05	***
CPI_nE	0.308133	0.125528	2.455	0.0141	**
hp_GDP_E	-0.656380	23.6167	-0.02779	0.9778	
hp_GDP_nE	-9.72009	10.6800	-0.9101	0.3628	
Mean dependent var	4.560526	S.D. dependent var	4.822934		
Sum squared resid	39.75694	S.E. of regression	0.891706		
R-squared	0.969504	Adjusted R-squared	0.965845		
F(6, 50)	265.7345	P-value(F)	3.92e-36		
rho	0.363078	Durbin-Watson	1.184104		

Hausman test -  
Null hypothesis: OLS estimates are consistent  
Asymptotic test statistic: Chi-square(4) = 15.092  
with p-value = 0.00451413

Equation 1: 3SLS, using observations 1997:3-2011:2 (T = 56)  
Dependent variable: REPO  
Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E REPO\_1\_E CPI\_1\_nE REPO\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	-0.564162	0.412362	-1.368	0.1713	
CPI_E	1.37206	0.0709737	19.33	2.89e-083	***
CPI_nE	1.31831	0.135905	9.700	3.01e-022	***
hp_GDP_E	-44.5503	24.9771	-1.784	0.0745	*
hp_GDP_nE	-42.1286	12.9791	-3.246	0.0012	***
u_E_1	-0.0196559	0.296576	-0.06628	0.9472	
u_nE_1	2.20266	0.306348	7.190	6.48e-013	***
Mean dependent var	4.204464	S.D. dependent var	4.040514		
Sum squared resid	154.3649	S.E. of regression	1.660276		
R-squared	0.832190	Adjusted R-squared	0.811641		

## Denmark

Model 3: OLS, using observations 1987:2-2011:3 (T = 98)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	-0.223910	0.239724	-0.9340	0.3528	
STI_1_E	0.883625	0.0418892	21.09	8.34e-037	***
STI_1_nE	0.981976	0.0301444	32.58	5.97e-052	***
CPI_E	0.253063	0.135484	1.868	0.0650	*
CPI_nE	0.129424	0.101239	1.278	0.2044	
hp_GDP_E	15.8420	10.3755	1.527	0.1303	
hp_GDP_nE	16.2402	5.81614	2.792	0.0064	***
Mean dependent var	5.308000	S.D. dependent var	3.285143		
Sum squared resid	52.23570	S.E. of regression	0.757640		
R-squared	0.950102	Adjusted R-squared	0.946812		
F(6, 91)	288.7839	P-value(F)	5.79e-57		
Log-likelihood	-108.2251	Akaike criterion	230.4502		
Schwarz criterion	248.5450	Hannan-Quinn	237.7692		
rho	-0.114061	Durbin-watson	2.226871		

Excluding the constant, p-value was highest for variable 10 (CPI\_nE)

Model 4: TSLS, using observations 1987:2-2011:3 (T = 98)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	-0.288103	0.269139	-1.070	0.2844	
STI_1_E	0.871186	0.0455391	19.13	1.41e-081	***
STI_1_nE	0.983635	0.0307166	32.02	5.22e-225	***
CPI_E	0.305965	0.168818	1.812	0.0699	*
CPI_nE	0.150248	0.113826	1.320	0.1868	
hp_GDP_E	23.0576	18.1778	1.268	0.2046	
hp_GDP_nE	16.0934	7.15020	2.251	0.0244	**
Mean dependent var	5.308000	S.D. dependent var	3.285143		
Sum squared resid	52.64060	S.E. of regression	0.760571		
R-squared	0.949718	Adjusted R-squared	0.946402		
F(6, 91)	286.1913	P-value(F)	8.54e-57		
rho	-0.099704	Durbin-watson	2.197734		

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 3.16538

with p-value = 0.02038

Equation 1: 3SLS, using observations 1987:3-2011:3 (T = 97)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	1.50668	0.981831	1.535	0.1249	
CPI_E	1.65054	0.429658	3.842	0.0001	***
CPI_nE	1.51293	0.397524	3.806	0.0001	***
hp_GDP_E	14.2221	62.1332	0.2289	0.8189	
hp_GDP_nE	-8.48933	26.8235	-0.3165	0.7516	
u_E_1	1.40266	0.749991	1.870	0.0615	*
u_nE_1	0.705486	0.478460	1.474	0.1403	
Mean dependent var	5.259973	S.D. dependent var	3.267442		
Sum squared resid	834.8628	S.E. of regression	2.933740		
R-squared	0.186442	Adjusted R-squared	0.132205		



## Estonia

Model 3: OLS, using observations 2000:2-2011:4 (T = 47)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	-0.373413	0.258586	-1.444	0.1565	
STI_1_E	1.08495	0.147050	7.378	5.61e-09	***
STI_1_nE	0.964854	0.0747083	12.91	7.46e-016	***
CPI_E	-0.0217466	0.178836	-0.1216	0.9038	
CPI_nE	0.101155	0.0387180	2.613	0.0126	**
hp_GDP_E	0.0639936	0.0994623	0.6434	0.5236	
hp_GDP_nE	0.0308405	0.0255332	1.208	0.2342	
Mean dependent var	3.810568	S.D. dependent var	1.870027		
Sum squared resid	12.77121	S.E. of regression	0.565049		
R-squared	0.920608	Adjusted R-squared	0.908699		
F(6, 40)	77.30449	P-value(F)	1.95e-20		
Log-likelihood	-36.07070	Akaike criterion	86.14139		
Schwarz criterion	99.09243	Hannan-Quinn	91.01495		
rho	0.020383	Durbin-Watson	1.935373		

Excluding the constant, p-value was highest for variable 8 (CPI\_E)

Model 4: TSLS, using observations 2000:2-2011:4 (T = 47)  
Dependent variable: STI  
Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE  
Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	-0.350189	0.296662	-1.180	0.2378	
STI_1_E	1.31350	0.341464	3.847	0.0001	***
STI_1_nE	0.953395	0.0998243	9.551	1.29e-021	***
CPI_E	-0.368401	0.516031	-0.7139	0.4753	
CPI_nE	0.109174	0.0539522	2.024	0.0430	**
hp_GDP_E	0.257358	0.282938	0.9096	0.3630	
hp_GDP_nE	0.0319668	0.0366433	0.8724	0.3830	
Mean dependent var	3.810568	S.D. dependent var	1.870027		
Sum squared resid	14.10535	S.E. of regression	0.593830		
R-squared	0.912502	Adjusted R-squared	0.899377		
F(6, 40)	70.31902	P-value(F)	1.09e-19		
rho	-0.049434	Durbin-Watson	2.075165		

Hausman test -

Null hypothesis: OLS estimates are consistent  
Asymptotic test statistic: Chi-square(4) = 4.66384  
with p-value = 0.004724

Equation 1: 3SLS, using observations 2000:3-2011:4 (T = 46)  
Dependent variable: STI  
Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	1.25877	0.396571	3.174	0.0015	***
CPI_E	0.883807	0.244041	3.622	0.0003	***
CPI_nE	0.553786	0.0714670	7.749	9.27e-015	***
hp_GDP_E	-0.543257	0.193855	-2.802	0.0051	***
hp_GDP_nE	-0.265298	0.0411923	-6.440	1.19e-010	***
u_E_1	1.57695	1.00467	1.570	0.1165	
u_nE_1	0.561953	0.342355	1.641	0.1007	
Mean dependent var	3.769928	S.D. dependent var	1.869589		
Sum squared resid	67.29465	S.E. of regression	1.209515		
R-squared	0.624106	Adjusted R-squared	0.566276		

## Hungary

Model 1: OLS, using observations 1995:2-2011:2 (T = 65)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	1.19709	0.634120	1.888	0.0641	*
STI_1_E	0.552405	0.359330	1.537	0.1297	
STI_1_nE	0.462787	0.125867	3.677	0.0005	***
CPI_E	0.350532	0.467800	0.7493	0.4567	
CPI_nE	0.498207	0.146541	3.400	0.0012	***
hp_GDP_E	26.9608	37.7151	0.7149	0.4776	
hp_GDP_nE	-4.88908	19.8818	-0.2459	0.8066	
Mean dependent var	11.42413	S.D. dependent var	7.679844		
Sum squared resid	426.4675	S.E. of regression	2.711621		
R-squared	0.887020	Adjusted R-squared	0.875333		
F(6, 58)	75.89427	P-value(F)	1.27e-25		
Log-likelihood	-153.3683	Akaike criterion	320.7367		
Schwarz criterion	335.9574	Hannan-Quinn	326.7422		
rho	0.020673	Durbin-watson	1.950337		

Excluding the constant, p-value was highest for variable 17 (hp\_GDP\_nE)

Model 2: TSLS, using observations 1995:2-2011:2 (T = 65)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	1.21934	0.666995	1.828	0.0675	*
STI_1_E	0.368443	0.479916	0.7677	0.4427	
STI_1_nE	0.529446	0.143112	3.700	0.0002	***
CPI_E	0.614118	0.658367	0.9328	0.3509	
CPI_nE	0.414001	0.169715	2.439	0.0147	**
hp_GDP_E	-5.17441	64.9224	-0.07970	0.9365	
hp_GDP_nE	-25.3600	27.6176	-0.9183	0.3585	
Mean dependent var	11.42413	S.D. dependent var	7.679844		
Sum squared resid	441.3972	S.E. of regression	2.758677		
R-squared	0.883065	Adjusted R-squared	0.870968		
F(6, 58)	72.60986	P-value(F)	3.92e-25		
rho	-0.023035	Durbin-watson	2.040802		

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 3.21421

with p-value = 0.021541

Equation 1: 3SLS, using observations 1995:3-2011:2 (T = 64)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	2.30840	0.671565	3.437	0.0006	***
CPI_E	0.898221	0.129790	6.921	4.50e-012	***
CPI_nE	0.953294	0.0558075	17.08	2.03e-065	***
hp_GDP_E	42.3520	51.6029	0.8207	0.4118	
hp_GDP_nE	-36.2248	30.0458	-1.206	0.2280	
u_E_1	0.581022	0.327122	1.776	0.0757	*
u_nE_1	0.415857	0.155420	2.676	0.0075	***
Mean dependent var	11.08128	S.D. dependent var	7.221796		
Sum squared resid	475.1390	S.E. of regression	2.724711		
R-squared	0.855431	Adjusted R-squared	0.840213		

## Chile

Model 1: OLS, using observations 1996:2-2010:4 (T = 59)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	18.7366	4.90242	3.822	0.0004	***
STI_1_E	0.354499	0.188310	1.883	0.0654	*
STI_1_nE	0.485865	0.109131	4.452	4.53e-05	***
CPI_E	-0.156370	0.0475193	-3.291	0.0018	***
CPI_nE	-0.156332	0.0452697	-3.453	0.0011	***
hp_GDP_E	12.8231	55.7594	0.2300	0.8190	
hp_GDP_nE	107.154	28.2841	3.788	0.0004	***
Mean dependent var	6.617288	S.D. dependent var	5.399736		
Sum squared resid	549.7764	S.E. of regression	3.251557		
R-squared	0.674903	Adjusted R-squared	0.637392		
F(6, 52)	17.99204	P-value(F)	3.66e-11		
Log-likelihood	-149.5606	Akaike criterion	313.1212		
Schwarz criterion	327.6640	Hannan-Quinn	318.7981		
rho	-0.136589	Durbin-Watson	2.183062		

Excluding the constant, p-value was highest for variable 16 (hp\_GDP\_E)

Model 2: TSLS, using observations 1996:2-2010:4 (T = 59)

Dependent variable: STI

Instrumented: STI\_1\_E STI\_1\_nE CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE  
Instruments: const CPI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE hp\_GDP\_1\_nE  
hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	13.1561	10.6205	1.239	0.2154	
STI_1_E	0.452942	0.946168	0.4787	0.6321	
STI_1_nE	0.682239	0.219593	3.107	0.0019	***
CPI_E	-0.105870	0.0758116	-1.396	0.1626	
CPI_nE	-0.112671	0.0978299	-1.152	0.2494	
hp_GDP_E	24.6551	100.555	0.2452	0.8063	
hp_GDP_nE	96.3520	42.0651	2.291	0.0220	**
Mean dependent var	6.617288	S.D. dependent var	5.399736		
Sum squared resid	584.5587	S.E. of regression	3.352837		
R-squared	0.661076	Adjusted R-squared	0.621970		
F(6, 52)	15.84739	P-value(F)	2.99e-10		
Log-likelihood	-370.8637	Akaike criterion	755.7275		
Schwarz criterion	770.2703	Hannan-Quinn	761.4044		
rho	-0.261135	Durbin-Watson	2.443238		

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(6) = 4.21281

with p-value = 0.012874

Equation 1: 3SLS, using observations 1996:2-2010:4 (T = 59)

Dependent variable: STI

Instruments: const STI\_1\_E STI\_1\_nE CPI\_1\_E CPI\_1\_nE hp\_GDP\_1\_E  
hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	19.5246	4.72397	4.133	3.58e-05	***
STI_1_E	0.349779	0.177623	1.969	0.0489	**
STI_1_nE	0.470032	0.103423	4.545	5.50e-06	***
CPI_E	-0.165238	0.0461321	-3.582	0.0003	***
CPI_nE	-0.162952	0.0436167	-3.736	0.0002	***
hp_GDP_E	-10.6939	56.7159	-0.1886	0.8504	
hp_GDP_nE	112.176	30.1377	3.722	0.0002	***
Mean dependent var	6.617288	S.D. dependent var	5.399736		
Sum squared resid	552.3720	S.E. of regression	3.059777		
R-squared	0.673385	Adjusted R-squared	0.635699		



## Japan

Model 2: OLS, using observations 1995:2-2011:1 (T = 64)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	-1.99736	1.26118	-1.584	0.1188	
STI_1_E	0.876359	0.113080	7.750	1.79e-010	***
STI_1_nE	0.597131	0.0390669	15.28	8.04e-022	***
CPI_E	0.0198730	0.0124970	1.590	0.1173	
CPI_nE	0.0204438	0.0124654	1.640	0.1065	
hp_GDP_E	0.0100711	0.00743680	1.354	0.1810	
hp_GDP_nE	0.0138132	0.00958586	1.441	0.1551	
Mean dependent var	0.211195	S.D. dependent var	0.247174		
Sum squared resid	0.549625	S.E. of regression	0.098196		
R-squared	0.857203	Adjusted R-squared	0.842171		
F(6, 57)	57.02782	P-value(F)	2.71e-22		
Log-likelihood	61.42482	Akaike criterion	-108.8496		
Schwarz criterion	-93.73746	Hannan-Quinn	-102.8962		
rho	0.455451	Durbin-watson	1.069189		

Excluding the constant, p-value was highest for variable 14 (hp\_GDP\_E)

Model 3: TSLS, using observations 1995:2-2011:1 (T = 64)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	-3.58022	1.62067	-2.209	0.0272	**
STI_1_E	0.872045	0.124998	6.976	3.03e-012	***
STI_1_nE	0.594453	0.0433860	13.70	9.95e-043	***
CPI_E	0.0355360	0.0160576	2.213	0.0269	**
CPI_nE	0.0359439	0.0160051	2.246	0.0247	**
hp_GDP_E	0.00725009	0.00854950	0.8480	0.3964	
hp_GDP_nE	0.0472641	0.0148582	3.181	0.0015	***
Mean dependent var	0.211195	S.D. dependent var	0.247174		
Sum squared resid	0.671296	S.E. of regression	0.108522		
R-squared	0.827499	Adjusted R-squared	0.809341		
F(6, 57)	47.89659	P-value(F)	1.73e-20		
rho	0.449745	Durbin-watson	1.082776		

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 23.296

with p-value = 0.000110498

Equation 1: 3SLS, using observations 1995:3-2011:1 (T = 63)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	-4.59042	2.28529	-2.009	0.0446	**
CPI_E	0.0464921	0.0226286	2.055	0.0399	**
CPI_nE	0.0473621	0.0225361	2.102	0.0356	**
hp_GDP_E	-0.0175917	0.0129332	-1.360	0.1738	
hp_GDP_nE	0.0642986	0.0216804	2.966	0.0030	***
u_E_1	1.36844	0.509479	2.686	0.0072	***
u_nE_1	0.804649	0.234288	3.434	0.0006	***
Mean dependent var	0.194244	S.D. dependent var	0.208314		
Sum squared resid	1.957365	S.E. of regression	0.176265		
R-squared	0.282673	Adjusted R-squared	0.205817		

## Moldova

Model 1: OLS, using observations 2000:2-2011:3 (T = 46)  
Dependent variable: REPO

	coefficient	std. error	t-ratio	p-value	
const	1.45747	0.461354	3.159	0.0031	***
REPO_1_E	0.694040	0.0382916	18.13	1.35e-020	***
REPO_1_nE	0.739212	0.0566275	13.05	8.17e-016	***
CPI_E	0.221749	0.0387691	5.720	1.27e-06	***
CPI_nE	0.173014	0.0840562	2.058	0.0463	**
hp_GDP_E	18.9791	8.57574	2.213	0.0328	**
hp_GDP_nE	-7.58642	26.0650	-0.2911	0.7725	
Mean dependent var	13.44130	S.D. dependent var	5.369618		
Sum squared resid	39.68627	S.E. of regression	1.008760		
R-squared	0.969413	Adjusted R-squared	0.964707		
F(6, 39)	206.0066	P-value(F)	6.10e-28		
Log-likelihood	-61.87554	Akaike criterion	137.7511		
Schwarz criterion	150.5516	Hannan-Quinn	142.5462		
rho	-0.248430	Durbin-watson	2.472872		

Excluding the constant, p-value was highest for variable 13 (hp\_GDP\_nE)

Model 2: TSLS, using observations 2000:2-2011:3 (T = 46)

Dependent variable: REPO

Instrumented: REPO\_1\_E REPO\_1\_nE CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	0.870489	0.611334	1.424	0.1545	
REPO_1_E	0.709823	0.0562129	12.63	1.49e-036	***
REPO_1_nE	0.723986	0.132776	5.453	4.96e-08	***
CPI_E	0.242966	0.0644669	3.769	0.0002	***
CPI_nE	0.306379	0.226647	1.352	0.1764	
hp_GDP_E	6.84593	15.9246	0.4299	0.6673	
hp_GDP_nE	-56.2273	85.5965	-0.6569	0.5113	

Mean dependent var	13.44130	S.D. dependent var	5.369618
Sum squared resid	46.93368	S.E. of regression	1.097009
R-squared	0.964656	Adjusted R-squared	0.959218
F(6, 39)	158.4954	P-value(F)	8.34e-26
Log-likelihood	-315.5786	Akaike criterion	645.1573
Schwarz criterion	657.9578	Hannan-Quinn	649.9524
rho	-0.074698	Durbin-watson	2.096341

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(6) = 14.0852

with p-value = 0.0286993

Equation 1: 3SLS, using observations 2000:3-2011:3 (T = 45)

Dependent variable: REPO

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E REPO\_1\_E CPI\_1\_nE REPO\_1\_nE hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	3.98894	1.16885	3.413	0.0006	***
CPI_E	0.861581	0.0876842	9.826	8.71e-023	***
CPI_nE	1.24784	0.154284	8.088	6.07e-016	***
hp_GDP_E	-56.3229	28.6501	-1.966	0.0493	**
hp_GDP_nE	-396.479	63.2756	-6.266	3.71e-010	***
u_E_1	1.66683	0.517570	3.221	0.0013	***
u_nE_1	1.69581	0.462068	3.670	0.0002	***

Mean dependent var	13.08822	S.D. dependent var	4.860358
Sum squared resid	528.4549	S.E. of regression	3.426871
R-squared	0.558905	Adjusted R-squared	0.489258

## Norway

Model 2: OLS, using observations 1980:2-2011:3 (T = 126)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	0.119477	0.158502	0.7538	0.4525	
STI_1_E	0.905452	0.0335323	27.00	1.40e-052	***
STI_1_nE	0.949801	0.0328085	28.95	1.05e-055	***
CPI_E	0.0783467	0.0476865	1.643	0.1030	
CPI_nE	0.0699863	0.0468442	1.494	0.1378	
hp_GDP_E	8.09302	4.25037	1.904	0.0593	*
hp_GDP_nE	4.00051	3.01457	1.327	0.1870	
Mean dependent var	8.076243	S.D. dependent var	4.360674		
Sum squared resid	76.61355	S.E. of regression	0.802379		
R-squared	0.967768	Adjusted R-squared	0.966143		
F(6, 119)	595.4956	P-value(F)	3.05e-86		
Log-likelihood	-147.4433	Akaike criterion	308.8865		
Schwarz criterion	328.7405	Hannan-Quinn	316.9525		
rho	0.210348	Durbin-Watson	1.577537		

Excluding the constant, p-value was highest for variable 18 (hp\_GDP\_nE)|

Model 3: TSLS, using observations 1980:2-2011:3 (T = 126)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	0.131527	0.161146	0.8162	0.4144	
STI_1_E	0.905976	0.0344920	26.27	4.66e-152	***
STI_1_nE	0.955702	0.0362040	26.40	1.46e-153	***
CPI_E	0.0808295	0.0494827	1.633	0.1024	
CPI_nE	0.0567429	0.0531722	1.067	0.2859	
hp_GDP_E	4.25341	4.64768	0.9152	0.3601	
hp_GDP_nE	5.58285	3.31365	1.685	0.0920	*
Mean dependent var	8.076243	S.D. dependent var	4.360674		
Sum squared resid	77.36376	S.E. of regression	0.806297		
R-squared	0.967452	Adjusted R-squared	0.965811		
F(6, 119)	589.2164	P-value(F)	5.62e-86		
rho	0.211125	Durbin-Watson	1.576695		

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 8.35251

with p-value = 0.079486

Equation 1: 3SLS, using observations 1980:3-2011:3 (T = 125)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	3.73820	0.362752	10.31	6.68e-025	***
CPI_E	0.889523	0.0864135	10.29	7.52e-025	***
CPI_nE	1.13071	0.0766776	14.75	3.25e-049	***
hp_GDP_E	4.07257	13.5993	0.2995	0.7646	
hp_GDP_nE	16.1717	9.81375	1.648	0.0994	*
u_E_1	1.13760	0.392377	2.899	0.0037	***
u_nE_1	0.930331	0.376744	2.469	0.0135	**
Mean dependent var	8.041120	S.D. dependent var	4.360290		
Sum squared resid	803.2986	S.E. of regression	2.535032		
R-squared	0.661588	Adjusted R-squared	0.644381		

## New Zealand

Model 2: OLS, using observations 1989:2-2010:4 (T = 87)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	1.39395	0.875829	1.592	0.1154	
STI_1_E	0.958052	0.0434030	22.07	9.00e-036	***
STI_1_nE	0.921207	0.0408888	22.53	2.19e-036	***
CPI_E	-0.0125772	0.00857753	-1.466	0.1465	
CPI_nE	-0.0100210	0.00745025	-1.345	0.1824	
hp_GDP_E	-0.0188725	0.0899641	-0.2098	0.8344	
hp_GDP_nE	0.239478	0.0488776	4.900	4.93e-06	***
Mean dependent var	7.286860	S.D. dependent var	2.685462		
Sum squared resid	36.76418	S.E. of regression	0.677903		
R-squared	0.940723	Adjusted R-squared	0.936277		
F(6, 80)	211.5983	P-value(F)	6.29e-47		
Log-likelihood	-85.97744	Akaike criterion	185.9549		
Schwarz criterion	203.2162	Hannan-Quinn	192.9055		
rho	0.379095	Durbin-watson	1.239904		

Excluding the constant, p-value was highest for variable 14 (hp\_GDP\_E)

Model 3: TSLS, using observations 1989:2-2010:4 (T = 87)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE

STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	1.07466	0.961362	1.118	0.2636	
STI_1_E	0.970557	0.0460602	21.07	1.45e-098	***
STI_1_nE	0.938937	0.0436153	21.53	8.56e-103	***
CPI_E	-0.0105545	0.00904407	-1.167	0.2432	
CPI_nE	-0.00780945	0.00812341	-0.9614	0.3364	
hp_GDP_E	0.0815606	0.140278	0.5814	0.5610	
hp_GDP_nE	0.293658	0.0563650	5.210	1.89e-07	***
Mean dependent var	7.286860	S.D. dependent var	2.685462		
Sum squared resid	37.87980	S.E. of regression	0.688112		
R-squared	0.938958	Adjusted R-squared	0.934380		
F(6, 80)	206.0536	P-value(F)	1.70e-46		
rho	0.370023	Durbin-watson	1.254671		

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 10.6468

with p-value = 0.0308332

Equation 1: 3SLS, using observations 1989:3-2010:4 (T = 86)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE

hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	18.7425	1.52254	12.31	8.00e-035	***
CPI_E	-0.118136	0.0168567	-7.008	2.41e-012	***
CPI_nE	-0.128526	0.0163973	-7.838	4.57e-015	***
hp_GDP_E	-1.01751	0.352551	-2.886	0.0039	***
hp_GDP_nE	-0.0352067	0.144687	-0.2433	0.8077	
u_E_1	1.33815	0.585010	2.287	0.0222	**
u_nE_1	1.02451	0.349003	2.936	0.0033	***
Mean dependent var	7.215196	S.D. dependent var	2.616196		
Sum squared resid	302.1641	S.E. of regression	1.874443		
R-squared	0.482479	Adjusted R-squared	0.443174		

## Poland

Model 1: OLS, using observations 1995:2-2011:3 (T = 66)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	0.527886	0.227207	2.323	0.0236	**
STI_1_E	0.823131	0.0479891	17.15	1.34e-024	***
STI_1_nE	0.828814	0.0416852	19.88	7.79e-028	***
CPI_E	0.198340	0.0598097	3.316	0.0016	***
CPI_nE	0.103317	0.0592435	1.744	0.0864	*
hp_GDP_E	37.3643	8.10296	4.611	2.20e-05	***
hp_GDP_nE	8.55069	7.16085	1.194	0.2372	

Mean dependent var	11.31588	S.D. dependent var	7.736361
Sum squared resid	52.95610	S.E. of regression	0.947397
R-squared	0.986388	Adjusted R-squared	0.985003
F(6, 59)	712.5564	P-value(F)	4.18e-53
Log-likelihood	-86.38362	Akaike criterion	186.7672
Schwarz criterion	202.0948	Hannan-Quinn	192.8239
rho	0.284189	Durbin-Watson	1.423999

Excluding the constant, p-value was highest for variable 18 (hp\_GDP\_nE)

Model 2: TSLS, using observations 1995:2-2011:3 (T = 66)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	0.477296	0.232044	2.057	0.0397	**
STI_1_E	0.828944	0.0556824	14.89	4.00e-050	***
STI_1_nE	0.859983	0.0437222	19.67	3.96e-086	***
CPI_E	0.193717	0.0705173	2.747	0.0060	***
CPI_nE	0.0534311	0.0626151	0.8533	0.3935	
hp_GDP_E	40.5447	9.74401	4.161	3.17e-05	***
hp_GDP_nE	9.96167	7.82776	1.273	0.2032	

Mean dependent var	11.31588	S.D. dependent var	7.736361
Sum squared resid	53.85628	S.E. of regression	0.955415
R-squared	0.986156	Adjusted R-squared	0.984749
F(6, 59)	699.6025	P-value(F)	7.12e-53
rho	0.279202	Durbin-Watson	1.437756

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 15.7654

with p-value = 0.00335061

Equation 1: 3SLS, using observations 1995:3-2011:3 (T = 65)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	3.68421	0.516691	7.130	1.00e-012	***
CPI_E	1.07882	0.0606254	17.79	7.75e-071	***
CPI_nE	1.10642	0.0756832	14.62	2.12e-048	***
hp_GDP_E	116.675	22.6208	5.158	2.50e-07	***
hp_GDP_nE	24.1044	20.0961	1.199	0.2304	
u_E_1	0.481873	0.590492	0.8161	0.4145	
u_nE_1	0.360965	0.451130	0.8001	0.4236	

Mean dependent var	11.04603	S.D. dependent var	7.476965
Sum squared resid	576.7286	S.E. of regression	2.978716
R-squared	0.839744	Adjusted R-squared	0.823166



## Romania

Model 2: OLS, using observations 2000:2-2011:3 (T = 46)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	0.805230	0.812462	0.9911	0.3277	
STI_1_E	0.590343	0.130715	4.516	5.69e-05	***
STI_1_nE	0.455207	0.147408	3.088	0.0037	***
CPI_E	0.324824	0.136477	2.380	0.0223	**
CPI_nE	0.529252	0.182141	2.906	0.0060	***
hp_GDP_E	20.1147	23.8900	0.8420	0.4049	
hp_GDP_nE	54.2931	30.7912	1.763	0.0857	*
Mean dependent var	15.20326	S.D. dependent var	11.70207		
Sum squared resid	347.8815	S.E. of regression	2.986643		
R-squared	0.943546	Adjusted R-squared	0.934861		
F(6, 39)	108.6384	P-value(F)	8.98e-23		
Log-likelihood	-111.8052	Akaike criterion	237.6105		
Schwarz criterion	250.4110	Hannan-Quinn	242.4056		
rho	0.263210	Durbin-watson	1.212256		

Excluding the constant, p-value was highest for variable 14 (hp\_GDP\_E)

Model 3: TSLS, using observations 2000:2-2011:3 (T = 46)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	0.666251	0.845985	0.7875	0.4310	
STI_1_E	0.673726	0.143024	4.711	2.47e-06	***
STI_1_nE	0.368853	0.178693	2.064	0.0390	**
CPI_E	0.232838	0.150206	1.550	0.1211	
CPI_nE	0.645023	0.223636	2.884	0.0039	***
hp_GDP_E	21.9693	24.5550	0.8947	0.3709	
hp_GDP_nE	76.4174	33.1002	2.309	0.0210	**
Mean dependent var	15.20326	S.D. dependent var	11.70207		
Sum squared resid	358.7677	S.E. of regression	3.033013		
R-squared	0.941789	Adjusted R-squared	0.932834		
F(6, 39)	105.0546	P-value(F)	1.66e-22		
rho	0.237233	Durbin-watson	1.243226		

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 9.52633

with p-value = 0.049209

Equation 1: 3SLS, using observations 2000:3-2011:3 (T = 45)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	1.93597	0.649886	2.979	0.0029	***
CPI_E	0.2628	0.1308	25.11	3.82e-139	***
CPI_nE	0.7505	0.1899	24.38	2.48e-131	***
hp_GDP_E	13.4291	20.6172	0.5501	0.5822	
hp_GDP_nE	81.680	28.8633	4.247	2.17e-05	***
u_E_1	1.09351	0.171595	6.373	1.86e-010	***
u_nE_1	0.626786	0.169902	3.689	0.0002	***
Mean dependent var	14.74156	S.D. dependent var	11.40272		
Sum squared resid	306.3905	S.E. of regression	2.609344		
R-squared	0.946501	Adjusted R-squared	0.938054		

## Russia

Model 1: OLS, using observations 2000:2-2011:3 (T = 46)  
Dependent variable: REPO

	coefficient	std. error	t-ratio	p-value	
const	-24.6604	5.89989	-4.180	0.0002	***
REPO_1_E	0.644168	0.0365816	17.61	3.69e-020	***
REPO_1_nE	0.774395	0.0367575	21.07	6.49e-023	***
CPI_E	0.261100	0.0558983	4.671	3.52e-05	***
CPI_nE	0.243818	0.0561493	4.342	9.71e-05	***
hp_GDP_E	-14.1997	9.01755	-1.575	0.1234	
hp_GDP_nE	-3.84861	6.49591	-0.5925	0.5570	

Mean dependent var	14.76413	S.D. dependent var	6.483078
Sum squared resid	27.61647	S.E. of regression	0.841495
R-squared	0.985399	Adjusted R-squared	0.983152
F(6, 39)	438.6642	P-value(F)	3.44e-34
Log-likelihood	-53.53590	Akaike criterion	121.0718
Schwarz criterion	133.8723	Hannan-Quinn	125.8669
rho	0.100797	Durbin-watson	1.793896

Excluding the constant, p-value was highest for variable 18 (hp\_GDP\_nE)

Model 2: TSLS, using observations 2000:2-2011:3 (T = 46)  
Dependent variable: REPO

Instrumented: REPO\_1\_E REPO\_1\_nE CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE hp\_GDP\_1\_nE  
hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	-39.7580	17.7851	-2.235	0.0254	**
REPO_1_E	0.618043	0.101345	6.098	1.07e-09	***
REPO_1_nE	0.668216	0.119314	5.600	2.14e-08	***
CPI_E	0.400154	0.170124	2.352	0.0187	**
CPI_nE	0.391652	0.172592	2.269	0.0233	**
hp_GDP_E	-17.2246	11.9585	-1.440	0.1498	
hp_GDP_nE	-11.1145	10.6696	-1.042	0.2975	

Mean dependent var	14.76413	S.D. dependent var	6.483078
Sum squared resid	34.13686	S.E. of regression	0.935577
R-squared	0.981980	Adjusted R-squared	0.979208
F(6, 39)	304.2082	P-value(F)	3.77e-31
Log-likelihood	-155.5593	Akaike criterion	325.1186
Schwarz criterion	337.9191	Hannan-Quinn	329.9137
rho	0.339212	Durbin-watson	1.303811

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(6) = 8.02517

with p-value = 0.01147

Equation 1: 3SLS, using observations 2000:2-2011:3 (T = 46)

Dependent variable: REPO

Instruments: const REPO\_1\_E REPO\_1\_nE CPI\_1\_E CPI\_1\_nE hp\_GDP\_1\_E  
hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	-27.4182	6.46055	-4.244	2.20e-05	***
REPO_1_E	0.650289	0.0348978	18.63	1.70e-077	***
REPO_1_nE	0.758180	0.0382356	19.83	1.67e-087	***
CPI_E	0.285178	0.0611423	4.664	3.10e-06	***
CPI_nE	0.270556	0.0615084	4.399	1.09e-05	***
hp_GDP_E	-16.3245	8.21175	-1.988	0.0468	**
hp_GDP_nE	-2.58889	6.11348	-0.4235	0.6720	

Mean dependent var	14.76413	S.D. dependent var	6.483078
Sum squared resid	28.14771	S.E. of regression	0.782245
R-squared	0.985152	Adjusted R-squared	0.982868

## Slovenia

Model 2: OLS, using observations 1950:2-1959:4 (T = 39)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	-0.0933213	0.157425	-0.5928	0.5575	
STI_1_E	0.901925	0.114304	7.891	5.28e-09	***
STI_1_nE	0.913630	0.0685971	13.32	1.34e-014	***
CPI_E	0.0996263	0.140477	0.7092	0.4833	
CPI_nE	0.0675037	0.0794841	0.8493	0.4020	
hp_GDP_E	0.0159477	0.0389093	0.4099	0.6846	
hp_GDP_nE	0.108311	0.0320987	3.374	0.0020	***

Mean dependent var	3.843770	S.D. dependent var	2.235735
Sum squared resid	5.808230	S.E. of regression	0.426037
R-squared	0.969421	Adjusted R-squared	0.963688
F(6, 32)	169.0798	P-value(F)	8.43e-23
Log-likelihood	-18.20503	Akaike criterion	50.41006
Schwarz criterion	62.05499	Hannan-Quinn	54.58816
rho	-0.248559	Durbin-Watson	2.376594

Excluding the constant, p-value was highest for variable 14 (hp\_GDP\_E)

Model 3: TSLS, using observations 1950:2-1959:4 (T = 39)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	-0.151371	0.185001	-0.8182	0.4132	
STI_1_E	0.872591	0.196138	4.449	8.63e-06	***
STI_1_nE	0.764183	0.120864	6.323	2.57e-010	***
CPI_E	0.147240	0.246761	0.5967	0.5507	
CPI_nE	0.264253	0.153443	1.722	0.0850	*
hp_GDP_E	0.0162476	0.0459317	0.3537	0.7235	
hp_GDP_nE	0.0342509	0.0556539	0.6154	0.5383	

Mean dependent var	3.843770	S.D. dependent var	2.235735
Sum squared resid	7.104718	S.E. of regression	0.471193
R-squared	0.962616	Adjusted R-squared	0.955607
F(6, 32)	137.4386	P-value(F)	2.05e-21
rho	-0.080938	Durbin-Watson	2.071117

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 5.58552

with p-value = 0.232314

Equation system, SE

Estimator: Three-Stage Least Squares

Equation 1: 3SLS, using observations 1950:3-1959:4 (T = 38)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	-0.455606	0.352018	-1.294	0.1956	
CPI_E	0.933719	0.140943	6.625	3.48e-011	***
CPI_nE	1.27614	0.100643	12.68	7.65e-037	***
hp_GDP_E	0.0643706	0.0803402	0.8012	0.4230	
hp_GDP_nE	-0.159598	0.0655953	-2.433	0.0150	**
u_E_1	3.05833	1.11059	2.754	0.0059	***
u_nE_1	0.676997	0.379372	1.785	0.0743	*

Mean dependent var	3.722115	S.D. dependent var	2.130917
Sum squared resid	47.76779	S.E. of regression	1.121181
R-squared	0.756951	Adjusted R-squared	0.709909



## Sweden

Model 1: OLS, using observations 1982:2-2011:3 (T = 118)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	0.0532915	0.151695	0.3513	0.7260	
STI_1_E	0.913947	0.0756818	12.08	6.00e-022	***
STI_1_nE	0.928655	0.0340068	27.31	4.47e-051	***
CPI_E	0.152061	0.119153	1.276	0.2046	
CPI_nE	0.0731268	0.0532492	1.373	0.1724	
hp_GDP_E	-16.0861	7.99922	-2.011	0.0468	**
hp_GDP_nE	16.5098	5.51228	2.995	0.0034	***
Mean dependent var	6.751794	S.D. dependent var	4.382477		
Sum squared resid	81.77100	S.E. of regression	0.858298		
R-squared	0.963611	Adjusted R-squared	0.961644		
F(6, 111)	489.8906	P-value(F)	2.06e-77		
Log-likelihood	-145.7958	Akaike criterion	305.5916		
Schwarz criterion	324.9864	Hannan-Quinn	313.4664		
rho	0.059424	Durbin-Watson	1.874684		

Excluding the constant, p-value was highest for variable 12 (CPI\_E)

Model 2: TSLS, using observations 1982:2-2011:3 (T = 118)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	0.0898065	0.155948	0.5759	0.5647	
STI_1_E	1.02796	0.0979920	10.49	9.57e-026	***
STI_1_nE	0.917183	0.0392118	23.39	5.34e-121	***
CPI_E	-0.0485935	0.158434	-0.3067	0.7591	
CPI_nE	0.0892268	0.0648766	1.375	0.1690	
hp_GDP_E	-0.372475	10.1299	-0.03677	0.9707	
hp_GDP_nE	14.3196	6.86792	2.085	0.0371	**
Mean dependent var	6.751794	S.D. dependent var	4.382477		
Sum squared resid	85.12627	S.E. of regression	0.875730		
R-squared	0.962118	Adjusted R-squared	0.960070		
F(6, 111)	469.3574	P-value(F)	2.02e-76		
rho	0.033930	Durbin-Watson	1.922269		

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 8.79773

with p-value = 0.0663589

Equation system, SW

Estimator: Three-Stage Least Squares

Equation 1: 3SLS, using observations 1982:3-2011:3 (T = 117)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	2.12379	0.326117	6.512	7.40e-011	***
CPI_E	1.29995	0.0898260	14.47	1.82e-047	***
CPI_nE	1.35693	0.0824881	16.45	8.38e-061	***
hp_GDP_E	-30.5906	19.1425	-1.598	0.1100	
hp_GDP_nE	-48.0732	14.7362	-3.262	0.0011	***
u_E_1	0.808000	0.413926	1.952	0.0509	*
u_nE_1	1.23067	0.277897	4.429	9.49e-06	***
Mean dependent var	6.698162	S.D. dependent var	4.362263		
Sum squared resid	596.3178	S.E. of regression	2.257595		
R-squared	0.736054	Adjusted R-squared	0.721657		

## Turkey

Model 1: OLS, using observations 2001:2-2011:3 (T = 42)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	1.05334	0.468000	2.251	0.0308	**
STI_1_E	1.11478	0.108720	10.25	4.38e-012	***
STI_1_nE	0.669933	0.0414126	16.18	8.09e-018	***
CPI_E	-0.200624	0.0987158	-2.032	0.0498	**
CPI_nE	0.287784	0.0537767	5.351	5.53e-06	***
hp_GDP_E	-9.81097	27.1027	-0.3620	0.7195	
hp_GDP_nE	21.7825	7.00427	3.110	0.0037	***

Mean dependent var	21.73929	S.D. dependent var	16.91137
Sum squared resid	118.2135	S.E. of regression	1.837805
R-squared	0.989918	Adjusted R-squared	0.988190
F(6, 35)	572.7839	P-value(F)	2.04e-33
Log-likelihood	-81.32669	Akaike criterion	176.6534
Schwarz criterion	188.8171	Hannan-Quinn	181.1118
rho	0.307168	Durbin-watson	1.379310

Excluding the constant, p-value was highest for variable 16 (hp\_GDP\_E)

Model 2: TSLS, using observations 2001:2-2011:3 (T = 42)

Dependent variable: STI

Instrumented: STI\_1\_E STI\_1\_nE CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE hp\_GDP\_1\_nE  
hp\_IPI\_nE

	coefficient	std. error	z	p-value
const	-2.00643	7.94897	-0.2524	0.8007
STI_1_E	0.740105	1.43484	0.5158	0.6060
STI_1_nE	1.60627	2.41845	0.6642	0.5066
CPI_E	0.173006	1.36015	0.1272	0.8988
CPI_nE	-0.874486	3.01113	-0.2904	0.7715
hp_GDP_E	120.405	403.989	0.2980	0.7657
hp_GDP_nE	30.6468	37.5086	0.8171	0.4139

Mean dependent var	21.73929	S.D. dependent var	16.91137
Sum squared resid	1931.072	S.E. of regression	7.427886
R-squared	0.871069	Adjusted R-squared	0.848967
F(6, 35)	32.25979	P-value(F)	7.23e-13
Log-likelihood	-400.9313	Akaike criterion	815.8626
Schwarz criterion	828.0263	Hannan-Quinn	820.3210
rho	0.116333	Durbin-watson	1.293419

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(6) = 8.12454

with p-value = 0.02012

Equation system, TUR

Estimator: Three-Stage Least Squares

Equation 1: 3SLS, using observations 2001:3-2011:3 (T = 41)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	2.90854	0.947240	3.071	0.0021	***
CPI_E	0.817225	0.0414333	19.72	1.35e-086	***
CPI_nE	1.06167	0.0473844	22.41	3.49e-111	***
hp_GDP_E	169.404	46.9386	3.609	0.0003	***
hp_GDP_nE	43.2221	15.4881	2.791	0.0053	***
u_E_1	0.543272	0.624527	0.8699	0.3844	
u_nE_1	0.613777	0.386402	1.588	0.1122	

Mean dependent var	20.73293	S.D. dependent var	15.79700
Sum squared resid	813.0630	S.E. of regression	4.453179
R-squared	0.925659	Adjusted R-squared	0.912540

## Unites States

Model 2: OLS, using observations 1980:2-2011:1 (T = 124)  
Dependent variable: STI

	coefficient	std. error	t-ratio	p-value	
const	4.02770	1.06214	3.792	0.0002	***
STI_1_E	0.715631	0.0702430	10.19	7.81e-018	***
STI_1_nE	0.760987	0.0545455	13.95	1.19e-026	***
CPI_E	-0.0315938	0.0104792	-3.015	0.0032	***
CPI_nE	-0.0346167	0.0100494	-3.445	0.0008	***
hp_GDP_E	0.102042	0.155897	0.6545	0.5140	
hp_GDP_nE	0.200860	0.0777922	2.582	0.0111	**
Mean dependent var	5.813226	S.D. dependent var	3.648789		
Sum squared resid	203.4451	S.E. of regression	1.318654		
R-squared	0.875765	Adjusted R-squared	0.869394		
F(6, 117)	137.4603	P-value(F)	1.43e-50		
Log-likelihood	-206.6455	Akaike criterion	427.2910		
Schwarz criterion	447.0330	Hannan-Quinn	435.3107		
rho	-0.037557	Durbin-Watson	1.853732		

Excluding the constant, p-value was highest for variable 14 (hp\_GDP\_E)

Model 3: TSLS, using observations 1980:2-2011:1 (T = 124)

Dependent variable: STI

Instrumented: CPI\_E CPI\_nE hp\_GDP\_E hp\_GDP\_nE

Instruments: const CPI\_1\_E STI\_1\_E hp\_GDP\_1\_E hp\_IPI\_E CPI\_1\_nE  
STI\_1\_nE hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	4.37849	1.09001	4.017	5.90e-05	***
STI_1_E	0.722120	0.0714054	10.11	4.84e-024	***
STI_1_nE	0.746522	0.0556843	13.41	5.55e-041	***
CPI_E	-0.0346737	0.0107344	-3.230	0.0012	***
CPI_nE	-0.0378632	0.0103062	-3.674	0.0002	***
hp_GDP_E	-0.167305	0.194088	-0.8620	0.3887	
hp_GDP_nE	0.231293	0.0957013	2.417	0.0157	**
Mean dependent var	5.813226	S.D. dependent var	3.648789		
Sum squared resid	208.8681	S.E. of regression	1.336113		
R-squared	0.872465	Adjusted R-squared	0.865925		
F(6, 117)	133.8215	P-value(F)	5.60e-50		
rho	-0.032802	Durbin-Watson	1.814948		

Hausman test -

Null hypothesis: OLS estimates are consistent

Asymptotic test statistic: Chi-square(4) = 10.3609

with p-value = 0.0347674

Equation system, US

Estimator: Three-Stage Least Squares

Equation 1: 3SLS, using observations 1980:3-2011:1 (T = 123)

Dependent variable: STI

Instruments: const u\_E\_1 u\_nE\_1 CPI\_1\_E STI\_1\_E CPI\_1\_nE STI\_1\_nE  
hp\_GDP\_1\_E hp\_IPI\_E hp\_GDP\_1\_nE hp\_IPI\_nE

	coefficient	std. error	z	p-value	
const	17.6623	0.723638	24.41	1.42e-131	***
CPI_E	-0.144223	0.00938738	-15.36	2.88e-053	***
CPI_nE	-0.150715	0.00886160	-17.01	7.21e-065	***
hp_GDP_E	-0.642742	0.271244	-2.370	0.0178	**
hp_GDP_nE	0.209981	0.134234	1.564	0.1177	
u_E_1	0.675730	0.211393	3.197	0.0014	***
u_nE_1	0.730908	0.167305	4.369	1.25e-05	***
Mean dependent var	5.791463	S.D. dependent var	3.655623		
Sum squared resid	469.5145	S.E. of regression	1.953763		
R-squared	0.712137	Adjusted R-squared	0.697248		